

**REPORT:
GAMMA RADIATION / RADIUM-226 CORRELATION
AND GAMMA CUTOFF LEVELS FOR REMEDIAL ACTION**

**MIDNITE MINE SUPERFUND SITE
STEVENS COUNTY, WA**

REVISION 1

PREPARED FOR:

DAWN MINING COMPANY
P.O. Box 250
FORD, WA 99013

PREPARED BY:



ENVIRONMENTAL RESTORATION GROUP INC.
8809 WASHINGTON ST. NE, SUITE 150
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SEPTEMBER 2, 2016

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ABSTRACT

Appendix S of the Midnite Mine Remedial Action (RA) Work Plan (MWH, 2015) specifies the development of statistical correlations between gamma radiation from surface materials or sediments and respective radium-226 concentrations to determine remedial criteria for cleanup of surface materials and sediments based on gamma survey readings (gamma cutoff levels). Gamma cutoff levels are designed to provide a 95% statistical probability of compliance with the U.S. Environmental Protection Agency's Record of Decision (ROD) (EPA, 2006) regarding cleanup levels for Ra-226 in surface materials (4.7 pCi/g) and sediments (13 pCi/g). The correlation data and statistical analysis presented in this report result in proposed gamma cutoff levels of 27 micro-roentgens per hour ($\mu\text{R}/\text{hr}$) for surface materials, and 41 $\mu\text{R}/\text{hr}$ for sediments, based on measurement readings with radiation detection instrumentation as specified in Appendix S.

1. Introduction

Appendix S of the Midnite Mine Remedial Action (RA) Work Plan (MWH, 2015) specifies use of statistical correlations between gamma radiation from surface materials or sediments¹ and respective radium-226 (Ra-226) concentrations. The primary purpose is to determine remedial criteria for cleanup of surface materials and sediments based on gamma survey readings (gamma cutoff levels²). These gamma-based criteria apply to measured gamma radiation levels above the ground surface prior to excavation, post excavation, and in all areas that require a final status survey to verify cleanup levels are achieved.³ They also apply to the borrow area soil stockpiles prior to use as final cover material (Section 3, Appendix S). Appendix S specifies that gamma cutoff levels should provide a 95% statistical probability of compliance with cleanup levels for Ra-226 in surface materials (4.7 pCi/g) and sediments (13 pCi/g) as specified in the U.S. Environmental Protection Agency (EPA) Record of Decision (ROD) for the Midnite Mine Superfund Site (EPA, 2006). This report provides correlation data (including final Ra-226 results from an approved offsite laboratory), statistical analysis and assessments, and proposed gamma cutoff levels.

2. Basis for Correlations and Determination of Gamma Cutoff Levels

A detailed explanation of the technical basis for development and use of gamma/Ra-226 correlations and gamma cutoff values at the Midnite Mine is provided in Attachment S-1 to Appendix S. The statistical relationship used to predict Ra-226 values based on gamma readings is based on least squares regression analysis. The regression may be linear or non-linear, depending on the model that provides the best statistical fit to site-specific correlation data. Associated gamma cutoff levels (a.k.a. “gamma guideline levels”) are developed based on the upper prediction limit (UPL) on the regression.

To determine a gamma reading at which there is a 95% probability of compliance with the Ra-226 cleanup level, a two-sided 90% prediction interval for the correlation data is calculated to generate the required one-sided 95% UPL. The appropriate UPL for this application at Midnite Mine has been calculated using the JMP statistical software package (SAS, 2013).

As indicated in Appendix S of the Remedial Action (RA) Work Plan (MWH, 2015), gamma cutoff levels represent remedial criteria that are used for two basic purposes:

1. Construction support.⁴

¹ As defined in the ROD (EPA, 2006), surface material includes soil, ore, proto-ore, waste rock, overburden, and materials used in haul road construction. Sediments include sediments in pits, ponds, creeks and drainages.

² Gamma cutoff levels are referred to in Appendix S as “gamma cutoff values”.

³ As indicated in Appendix S, gamma cutoff levels do not apply in areas of exposed bedrock that exceed these criteria due to natural geologic characteristics, or in areas where gamma shine renders these criteria unreliable.

⁴ Construction support is referred to in Appendix S as “remedial support”. Construction support measurements are not intended to demonstrate compliance with ROD cleanup levels, only to provide 1) preliminary characterization

2. Final status surveys (FSS).⁵

As previously discussed with the U.S Environmental Protection Agency (EPA), interim (preliminary) gamma cutoff levels were developed early in the Midnite Mine RA project for construction support purposes based on onsite analytical data, including gamma scans and Ra-226 concentrations in soil samples from corresponding locations. Final gamma cutoff levels for Remedial Action at the Midnite Mine are proposed in this report based on 1) previous correlation data generated by Tetra Tech (Miller Geotechnical, 2011), and 2) new (2016) sampling and analytical results for Ra-226 concentrations in correlation soil samples as determined by an approved offsite analytical laboratory [Inter-Mountain Labs (IML), Sheridan, WY].

3. Methods

Correlation data presented in this report were generated in two separate studies. The first was conducted in 2010 by Tetra Tech as reported in the 2011 Mine Waste Investigations Study Report (Miller Geotechnical, 2011). These historic (2010) data, comprised of gamma scans and composite soil sampling across various 100 m² areas (termed “correlation plots”), were reported and evaluated in the Midnite Mine RA Work Plan (Appendix S, Attachment S-1). Appendix S indicates that the historic (2010) correlation data evaluated in Attachment S-1 will be considered in future correlation analysis, and that “Early in the cleanup sequence, additional gamma/soil Ra-226 correlation data will be collected to verify the validity of the initial correlation and respective gamma cutoff value, and to update these assessment criteria as warranted.”

In accordance with Appendix S specifications, new correlation data were collected early in the RA project (in February and June of 2016). Data were collected by Environmental Restoration Group, Inc. (ERG)⁶ across 24 correlation plots representing an applicable range of gamma readings as specified in Appendix S (from about 15 – 60 $\mu\text{R}/\text{hr}$ ⁷). Composite soil samples for 4 of the new correlation plots were collected in late February 2016, and the remaining 20 samples were collected in June of 2016. The Ra-226 results for the 4 samples collected in February were determined only at an offsite laboratory (IML) since the

data, or 2) interim data as needed to support “real time” decisions regarding the approximate spatial extent of excavation needed in any given area.

⁵ Final status gamma surveys are intended to provide final documentation of gamma readings across the Survey Unit to verify that at least 95% of recorded/mapped values, including readings across areas that lie between direct FSS sampling locations, are below the gamma cutoff level. As indicated in Appendix S, this criterion does not apply in areas excavated to bedrock that exceeds the gamma cutoff due to natural geologic characteristics, or in areas where gamma shine renders the gamma cutoff unreliable.

⁶ ERG is a subcontracted technical consultant to Dawn Mining Company / Newmont.

⁷ Micro-roentgen per hour ($\mu\text{R}/\text{hr}$), a measure of gamma radiation exposure rate. In this report, this measure is specific to particular instrumentation required by Appendix S of the RA Work Plan (Ludlum Model 44-10 detectors paired with Ludlum 2350 ratemeters) because these sodium iodide (NaI) detectors are energy dependent.

onsite lab was not yet operational at that time.⁸ The 20 samples collected in June were estimated in the onsite lab before being sent to the offsite laboratory (IML) for confirmatory analysis. The new correlation data were generated in accordance with the method specified for this purpose in Appendix S (Section S.2.1.3) along with applicable standard operating procedures (AS-SOPs 1, 2, 3 and 6 – see Attachment S-2 to Appendix S). The locations of the 24 correlation plots scanned/sampled in 2016 are shown in Figure 1.

Correlation plot locations were selected based on gamma screening surveys conducted for this purpose (identification of appropriate correlation plot locations). Finding suitable locations was an iterative process. Selection criteria were based on 1) locations with relatively uniform gamma readings, 2) gamma readings within the range of interest with respect to ROD cleanup levels (< 60 $\mu\text{R}/\text{hr}$), and 3) to the extent possible, locations not strongly affected by gamma shine from adjacent areas. Other criteria for correlation plot selection included locations with gamma readings likely to encompass the Ra-226 cleanup level for surface materials (generally between 15 and 40 $\mu\text{R}/\text{hr}$), and obtaining correlation data from both natural (undisturbed) areas, as well as areas disturbed by historic mine operations, or more recently, by remedial excavations, such that correlation data would be adequately representative of variable site conditions.

With respect to the statistical analysis of correlation data as presented in this report, the historic (2010) data were collected in a manner consistent with Appendix S specifications, and soil Ra-226 results were analyzed by one of the approved laboratories for the RA project [Energy Laboratories Inc. (ELI)]. Of the historic correlation data evaluated in Appendix S (Attachment 1), only paired values with gamma readings below 60 $\mu\text{R}/\text{hr}$ were considered in this report since the available data indicate that higher values are not relevant to ROD cleanup levels for Ra-226 in surface materials (4.7 pCi/g) or sediments (13 pCi/g).

The new (2016) correlation data also include soil Ra-226 results from an approved offsite lab [Inter-Mountain Labs (IML), Sheridan, WY]. These data, which are summarized in Attachment 1 (complete laboratory reports are provided in Attachment 2), have been validated



Figure 1: Correlation plot locations sampled/scanned in 2016.

⁸ These four (4) samples were collected primarily to serve as calibration standards for the onsite gamma spectroscopy system, but doubled as correlation plot samples since respective locations appeared suitable for this purpose [per the Inspection and Test Plan for Appendix S (ITP 13)].

in accordance with the Quality Assurance Project Plan (QAPP) (Attachment S-2, Appendix S of the RA Work Plan). The Ra-226 values for all correlation data considered in this report were generated using gamma spectroscopy with a high-purity germanium (HPGe) detector (EPA Method 901.1M). The gamma readings were all generated with methods and instruments that are consistent with those indicated in Appendix S.

4. Correlation Results

All paired gamma/Ra-226 correlation data as described in the preceding section ($n = 33$) are plotted in Figure 2. A table of results is provided in Attachment 1. The best fit regression model is a non-linear exponential function. There are several features of this statistical relationship that warrant discussion. First, the degree of data scatter about the regression curve (referred to as “residuals”) increases with increasing values. This is not uncommon for environmental data as confounding factors that influence the relationship between paired variables tend to be more pronounced at higher levels. For gamma/Ra-226 correlation data, such factors in the statistical relationship can include small “hot spot effects”⁹ and “gamma shine”¹⁰. Both factors appear to be present in this data set (Figure 2, right), but this has not been confirmed. Assuming these factors are part of site characteristics, the data are generally expected to be representative. However, there are several exceptions as the distribution of residuals about the regression curve do not follow a normal (Gaussian) data distribution as would be expected in the absence of outliers.

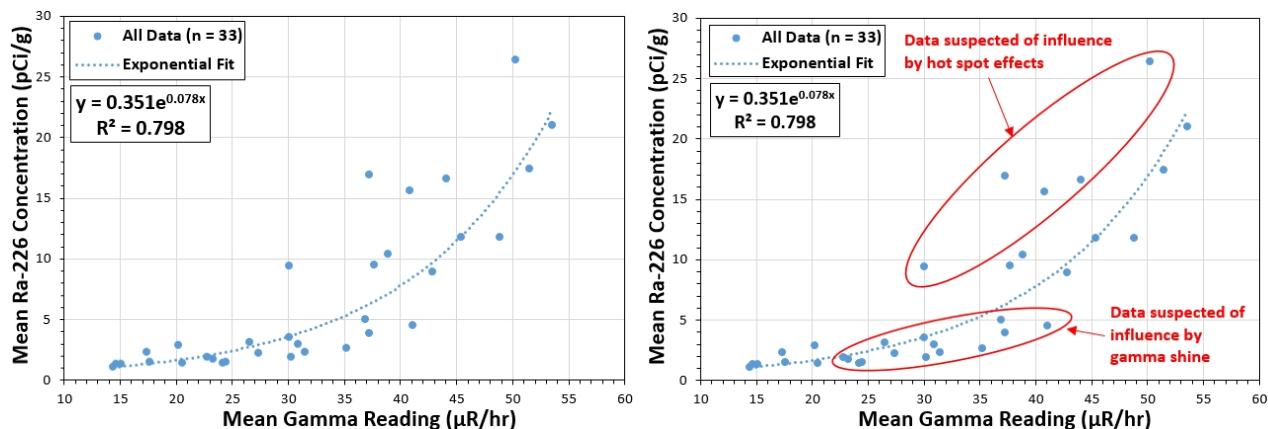


Figure 2: Correlation data and fitted regression curve (left), and illustration of data suspected of being influenced by confounding factors (right).

⁹ The concept of a hot spot effect for correlation data is an extension of the “hot particle” effect described in Appendix S of the RA Work Plan (Section S.2.1.3). In this case, the correlation plot itself may have elevated and relatively uniform gamma readings across the plot, but soil Ra-226 levels and associated gamma readings drop off rapidly beyond the limits of the plot being scanned/sampled. Under this circumstance, average gamma readings tend to be significantly lower than would be expected if the elevated soil Ra-226 concentrations extended well beyond the plot. This circumstance can create “outliers” in correlation data that tend to lower the gamma cutoff level in a non-representative manner and may result in unnecessary remediation.

¹⁰ Gamma shine refers to a circumstance in which scattered gamma radiation from elevated levels of Ra-226 in nearby materials (e.g. mine wastes) produce exposure rates at a location of interest that are not representative of the levels of Ra-226 in soils at the location of interest. Midnite Mine has very large quantities of above-grade mine wastes that appear to contribute to gamma shine effects in adjacent areas.

Statistical analysis confirms that residuals on the regression are not normally distributed, and indicates the presence of 5 statistical outliers (Figure 3). All of these outliers are suspected of being influenced by hot spot effects as shown in Figure 2. The number of outliers in this data set is believed related to the fact that locations with uniform Ra-226 contamination across areas larger than a 100 m² correlation plot, and that also have values in the range of interest for ROD cleanup levels, are currently a relatively rare occurrence at the site. In these cases, data were collected in the range of primary interest, even though the criterion of uniform radiological conditions beyond the correlation plot could not be met (for higher target levels of interest, it was difficult to find suitable locations that met all prescribed criteria). Appendix S specifies that obvious outliers which are non-representative relative to the majority of the correlation data will be excluded from the statistical analysis. Accordingly, the five identified outliers were omitted from determination of proposed final gamma cutoff levels for surface materials and sediments (Figure 4).

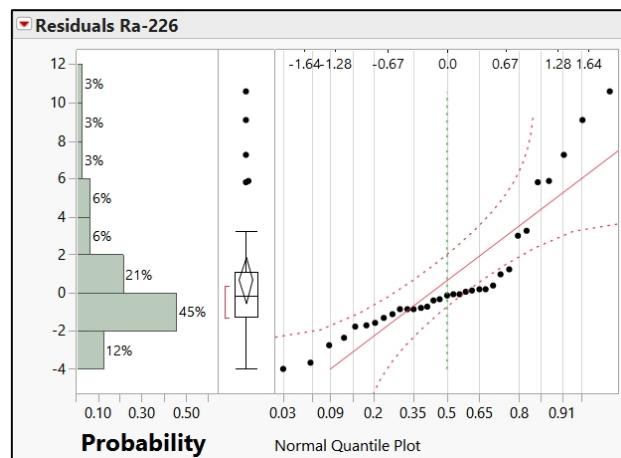


Figure 3: Histogram of regression residuals with outlier box plot and normal quantile plot.

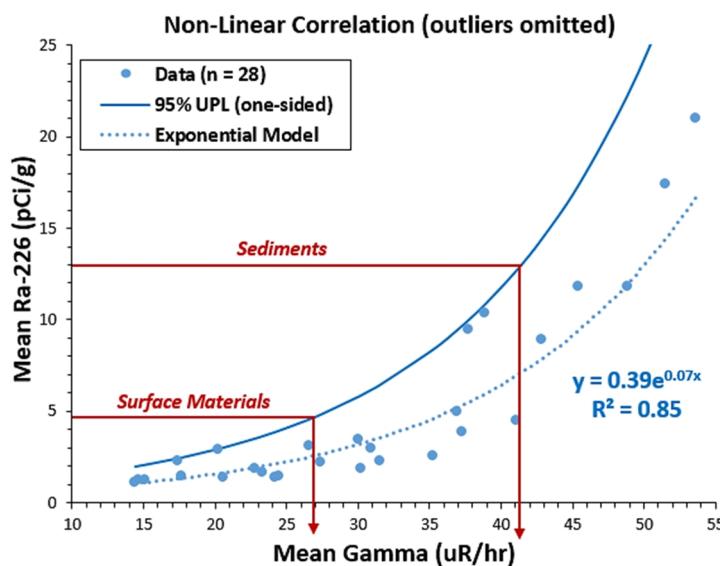


Figure 4: Final correlation data set and proposed gamma cutoff levels for surface materials (27 $\mu\text{R}/\text{hr}$) and sediments (41 $\mu\text{R}/\text{hr}$).

Given the above analyses of final gamma/Ra-226 correlation data, it is proposed that the gamma cutoff level for surface materials, rounded to the nearest whole number for practical use in the field, be established at 27 $\mu\text{R}/\text{hr}$, and the gamma cutoff level for sediments be established at 41 $\mu\text{R}/\text{hr}$. As

previously indicated, these gamma cutoff levels are based on a 95% probability of compliance with ROD cleanup levels for Ra-226 in surface materials (4.7 pCi/g) and sediments (13 pCi/g). These gamma-based criteria are generally expected to meet the required probability of compliance with ROD cleanup levels as specified in Appendix S (95%). Application of gamma cutoff levels is based on a detector height of 1 meter above the ground surface, and mandatory use of the gamma survey instrumentation specified in Appendix S.

5. Quality Assurance / Quality Control

Offsite laboratory data reports for the 2016 correlation soil samples shown in the Table 1 data summary (Attachment 1) are provided in Attachment 2. These data have been reviewed by the Quality Assurance Manager (Jill Richards, Worthington Miller Environmental), and have been validated in accordance with the requirements of the QAPP (Attachment S-2 to Appendix S, RA Work Plan).

Gamma scan detectors used to collect the gamma data shown in the Table 1 data summary (Attachment 1) were in current calibration and at the time of these scans, and were functioning within quality control (QC) tolerance limits for static background, a static Cs-137 source check, and field strip measurements as detailed in the QAPP. QC charts that include applicable QC data for these parameters during the period of interest are shown in Figure 5.

6. Conclusions

Based on the gamma/Ra-226 correlation data presented in this report, the gamma cutoff level for surface materials, rounded to the nearest whole number for practical use in the field, will be established at 27 $\mu\text{R}/\text{hr}$, and the gamma cutoff level for sediments will be established at 41 $\mu\text{R}/\text{hr}$. These values are based on a 95% probability of compliance with the Ra-226 cleanup levels of 4.7 pCi/g for surface material and 13 pCi/g for sediments as specified in the ROD. The gamma cutoff levels were based on measurements with the specific gamma survey instrumentation indicated in Appendix S, and are defined at a detector height of 1 meter above the ground surface. These gamma-based remedial criteria will be used to support cleanup and verification activities at the Midnite Mine Superfund Site as noted in this report as well as in Appendix S of the approved RA Work Plan.

7. References

Miller Geotechnical Consultants, Inc. (Miller Geotechnical), 2011. Mine Waste Investigations. February 11.

MWH Americas, Inc. (MWH). 2015. Midnite Mine Superfund Site Remedial Action Work Plan. Revision 1. December 2015.

SAS Institute Inc. (SAS). 2013. JMP version 11.2.1.

U.S. Environmental Protection Agency (EPA). 2006. Midnite Mine Superfund Site, Spokane Indian Reservation, Washington, Record of Decision. Office of Environmental Cleanup. EPA Region 10. September.

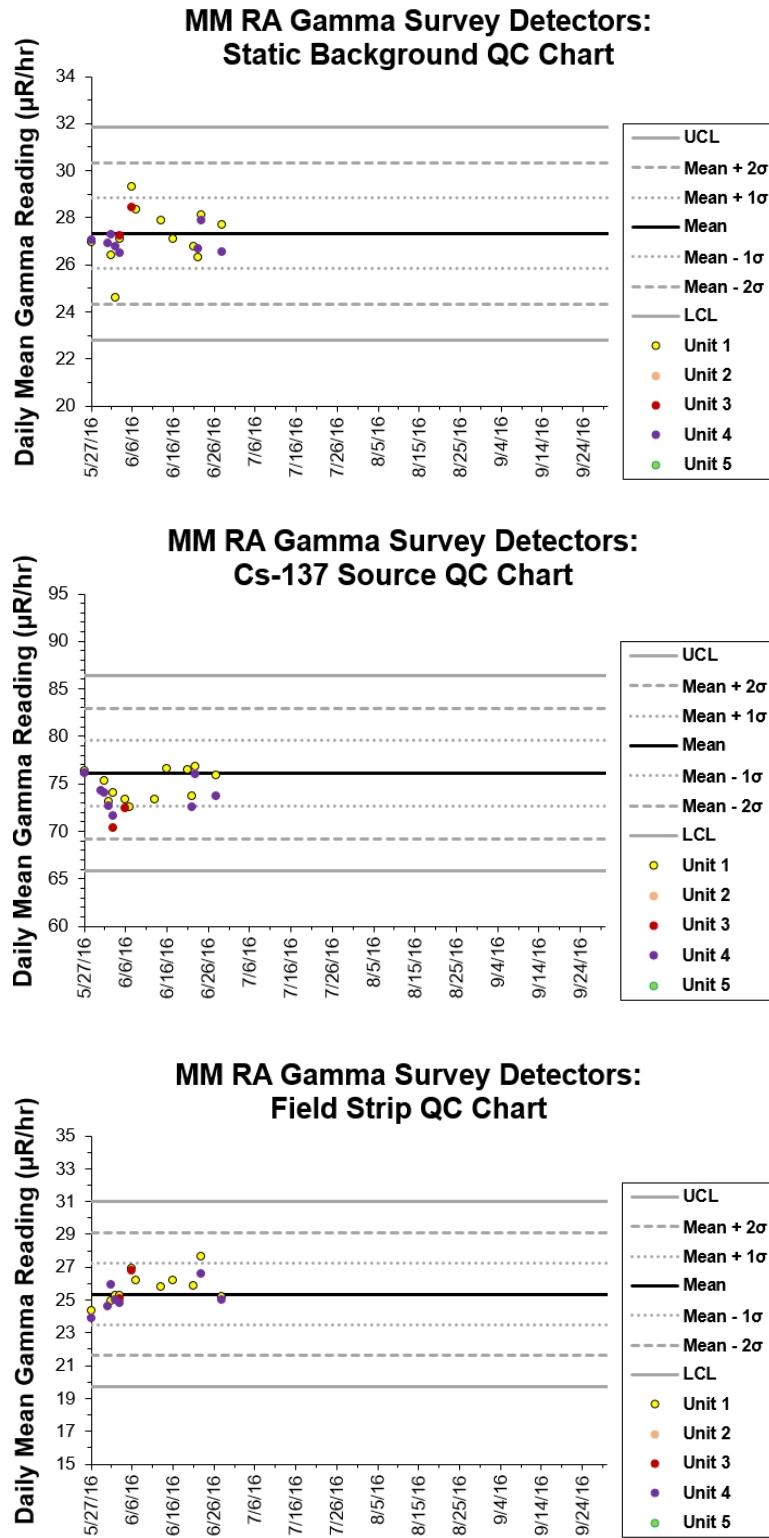


Figure 5: QC charts for gamma survey instruments during late May and June, 2016.

ATTACHMENT 1 – Summary Correlation Data Table

Table 1: Gamma/Ra-226 correlation data.

Correlation Plot ID	Sampling Date	Easting (State Plane, Feet, WGS-84)	Northing (State Plane, Feet, WGS-84)	Mean Gamma (μ R/hr)	Mean Ra-226 (pCi/g)	Data Source
CORR-1*	2/29/16	2309773.96	353726.68	38.9	10.4	ERG / IML
CORR-2*	2/29/16	2309812.66	353534.60	24.2	1.4	ERG / IML
CORR-3*	2/29/16	2309934.29	353217.72	48.8	11.8	ERG / IML
CORR-4*	3/1/16	2309750.00	352521.80	15.1	1.3	ERG / IML
CORR-5	6/6/16	2309322.19	354456.26	31.5	4.5	ERG / IML
CORR-6	6/6/16	2309041.09	354402.73	26.5	4.2	ERG / IML
CORR-7	6/6/16	2309173.25	354332.12	23.3	3.1	ERG / IML
CORR-8	6/6/16	2309276.54	354292.34	30.0	4.0	ERG / IML
CORR-9	6/6/16	2309051.09	354201.69	27.4	4.6	ERG / IML
CORR-10	6/6/16	2308658.80	353838.66	14.7	1.9	ERG / IML
CORR-11	6/6/16	2309455.69	353594.34	37.3	11.7	ERG / IML
CORR-12	6/7/16	2309624.55	354483.02	41.1	5.2	ERG / IML
CORR-13	6/7/16	2309607.90	354601.27	36.9	5.3	ERG / IML
CORR-14	6/7/16	2309472.28	354693.10	44.1	11.3	ERG / IML
CORR-15	6/7/16	2309813.89	354397.99	53.6	14.2	ERG / IML
CORR-16	6/13/16	2309600.30	352320.80	14.4	0.9	ERG / IML
CORR-17	6/13/16	2309890.19	352597.68	20.5	3.0	ERG / IML
CORR-18	6/16/16	2309547.15	354565.08	45.4	8.6	ERG / IML
CORR-19	6/16/16	2309430.26	354577.04	35.2	4.2	ERG / IML
CORR-20	6/16/16	2312328.24	355146.04	42.8	9.4	ERG / IML
CORR-21	6/16/16	2311105.59	352141.30	40.8	14.3	ERG / IML
CORR-22	6/16/16	2312317.74	352646.67	30.1	8.8	ERG / IML
CORR-23	6/16/16	2310318.09	351093.45	24.4	3.3	ERG / IML
CORR-24	6/21/16	2309460.14	354479.99	30.2	2.8	ERG / IML
TT-SOILCORR3	8/8/2010	NP**	NP**	50.3	26.4	TT / ELI
TT-SOILCORR4	8/9/2010	NP**	NP**	51.5	17.4	TT / ELI
TT-SOILCORR5	8/9/2010	NP**	NP**	17.6	1.5	TT / ELI
TT-SOILCORR6	8/9/2010	NP**	NP**	37.7	9.5	TT / ELI
TT-SOILCORR8	8/9/2010	NP**	NP**	22.8	1.9	TT / ELI
TT-SOILCORR9	8/9/2010	NP**	NP**	30.9	3.0	TT / ELI
TT-MMDSOILCORR1	9/1/2010	NP**	NP**	20.2	2.9	TT / ELI
TT-MMDSOILCORR2	9/1/2010	NP**	NP**	17.4	2.3	TT / ELI
TT-MMDSOILCORR3	9/1/2010	NP**	NP**	37.2	3.9	TT / ELI

*Official gamma scan of correlation plot occurred on 5-31-16.

**Coordinates not provided in report, but a map of locations was shown (Figure 17).

[Yellow Box] = Identified statistical outlier based on analysis of regression residuals.

ATTACHMENT 2 – Laboratory Data Reports¹¹

¹¹ **Note:** In lab report S160418002, there are analytical results and QC summaries for 10 samples. Only 4 of these samples pertain to the correlation data presented in this report. The relevant data results have a client ID prefix of “CORR” (CORR samples 1-4). Sample analysis results for the other 6 samples pertain only to calibration of onsite analytical systems and should be ignored in the context of this report.



Inter-Mountain Labs

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

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Date: 6/1/2016

CLIENT: Environmental Restoration Group, Inc.
Project: Midnite Mine
Lab Order: S1604180

CASE NARRATIVE
Report ID: S1604180002
(Replaces S1604180001)

This report contains:

Case Narrative - 1 page
Sample Analysis Report - 10 pages
Analytical QC Summary Report - 1 page
Gamma Spec LIMS Report and Export File - 2 pages
Gamma Spec Ra 226 Spectrum and ROI Data - 30 pages
Gamma Spec Ra 226 Standards Certificates - 17 pages
Gamma Spec Ra 226 ROI Calibration and Blanks - 18 pages
Original COC, Condition Upon Receipt and Supporting Documentation - 3 page

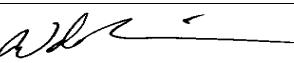
Samples CAL1-0015-SOI-COM-01, CAL2-0015-SOI-COM-01, CAL3-0015-SOI-COM-01, CAL4-0015-SOI-COM-01, CAL5-0015-SOI-COM-01, CAL6-0015-SOI-COM-01, CORR1-0015-SOI-COM-01, CORR2-0015-SOI-COM-01, CORR3-0015-SOI-COM-01, and CORR4-0015-SOI-COM-01 were received on April 13, 2016. .

All samples were received and analyzed within the EPA recommended holding times, except those noted below in this case narrative. Samples were analyzed using the methods outlined in the following references:

U.S.E.P.A. 600 "Methods for Chemical Analysis of Water and Wastes", 1993
"Standard Methods For The Examination of Water and Wastewater", 20th ed., 1998
Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, 3rd Edition
Methods indicated with the Monday, March 12, 2007 Federal Register, 40 CFR Part 122, 136 et al.
US EPA Methods from Technology Transfer Network Ambient Monitoring Technology Information Center, 2009

All Quality objectives were achieved except as noted below:

Work order S1604180 was revised because the client requested a Level 4 Report. Report ID S160418001 was replaced with Report ID S160418002.

Reviewed by: 

Wade Nieuwsma, Assistant Laboratory Manager

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Sample Analysis Report

Company:	Environmental Restoration Group, Inc. 8809 Washington St. NE. Suite 150 Albuquerque, NM 87113	Date Reported	6/1/2016
		Report ID	S1604180002
		(Replaces S1604180001)	
ProjectName:	Midnite Mine	WorkOrder:	S1604180
Lab ID:	S1604180-001	CollectionDate:	3/1/2016
ClientSample ID:	CAL1-0015-SOI-COM-01	DateReceived:	4/13/2016 10:30:00 AM
COC:	WEB	FieldSampler:	RW
		Matrix:	Soil

Comments

Analyses	Result	Units	Qual	RL	Method	Date Analyzed/Init
Radionuclides - Total						
Radium 226	18.0	pCi/g		0.2	E901.1 Mod.	04/14/2016 2110 WN
Radium 226 Precision (\pm)	0.5	pCi/g			E901.1 Mod.	04/14/2016 2110 WN

These results apply only to the samples tested.**RL - Reporting Limit**

Qualifiers:	B Analyte detected in the associated Method Blank	C Calculated Value
E Value above quantitation range	H Holding times for preparation or analysis exceeded	
J Analyte detected below quantitation limits	L Analyzed by another laboratory	
M Value exceeds Monthly Ave or MCL or is less than LCL	ND Not Detected at the Reporting Limit	
O Outside the Range of Dilutions	S Spike Recovery outside accepted recovery limits	
X Matrix Effect		

Reviewed by:

Wade Nieuwsma, Assistant Laboratory Manager

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Sample Analysis Report

Company:	Environmental Restoration Group, Inc. 8809 Washington St. NE. Suite 150 Albuquerque, NM 87113	Date Reported	6/1/2016
		Report ID	S1604180002
		(Replaces S1604180001)	
ProjectName:	Midnite Mine	WorkOrder:	S1604180
Lab ID:	S1604180-002	CollectionDate:	3/1/2016
ClientSample ID:	CAL2-0015-SOI-COM-01	DateReceived:	4/13/2016 10:30:00 AM
COC:	WEB	FieldSampler:	RW
		Matrix:	Soil

Comments

Analyses	Result	Units	Qual	RL	Method	Date Analyzed/Init
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Radionuclides - Total

Radium 226	26.5	pCi/g	0.2	E901.1 Mod.	04/14/2016 2226	WN
Radium 226 Precision (\pm)	0.6	pCi/g		E901.1 Mod.	04/14/2016 2226	WN

These results apply only to the samples tested.**RL - Reporting Limit**

Qualifiers:

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL or is less than LCL
O	Outside the Range of Dilutions
X	Matrix Effect

C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by another laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

Reviewed by: A. Nieuwsma

Wade Nieuwsma, Assistant Laboratory Manager

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Sample Analysis Report

Company:	Environmental Restoration Group, Inc. 8809 Washington St. NE. Suite 150 Albuquerque, NM 87113	Date Reported	6/1/2016
		Report ID	S1604180002
		(Replaces S1604180001)	
ProjectName:	Midnite Mine	WorkOrder:	S1604180
Lab ID:	S1604180-003	CollectionDate:	3/1/2016
ClientSample ID:	CAL3-0015-SOI-COM-01	DateReceived:	4/13/2016 10:30:00 AM
COC:	WEB	FieldSampler:	RW
		Matrix:	Soil

Comments

Analyses	Result	Units	Qual	RL	Method	Date Analyzed/Init
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Radionuclides - Total

Radium 226	12.4	pCi/g	0.2	E901.1 Mod.	04/14/2016 2342	WN
Radium 226 Precision (\pm)	0.4	pCi/g		E901.1 Mod.	04/14/2016 2342	WN

These results apply only to the samples tested.**RL - Reporting Limit**

Qualifiers:

- B Analyte detected in the associated Method Blank
- E Value above quantitation range
- J Analyte detected below quantitation limits
- M Value exceeds Monthly Ave or MCL or is less than LCL
- O Outside the Range of Dilutions
- X Matrix Effect

- C Calculated Value
- H Holding times for preparation or analysis exceeded
- L Analyzed by another laboratory
- ND Not Detected at the Reporting Limit
- S Spike Recovery outside accepted recovery limits

Reviewed by: A. Nieuwsma

Wade Nieuwsma, Assistant Laboratory Manager

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Sample Analysis Report

Company:	Environmental Restoration Group, Inc. 8809 Washington St. NE. Suite 150 Albuquerque, NM 87113	Date Reported	6/1/2016
		Report ID	S1604180002
		(Replaces S1604180001)	
ProjectName:	Midnite Mine	WorkOrder:	S1604180
Lab ID:	S1604180-004	CollectionDate:	3/1/2016
ClientSample ID:	CAL4-0015-SOI-COM-01	DateReceived:	4/13/2016 10:30:00 AM
COC:	WEB	FieldSampler:	RW
		Matrix:	Soil

Comments

Analyses	Result	Units	Qual	RL	Method	Date Analyzed/Init
----------	--------	-------	------	----	--------	--------------------

Radionuclides - Total

Radium 226	3.4	pCi/g	0.2	E901.1 Mod.	04/15/2016 2159	WN
Radium 226 Precision (\pm)	0.3	pCi/g		E901.1 Mod.	04/15/2016 2159	WN

These results apply only to the samples tested.**RL - Reporting Limit**

Qualifiers:	B Analyte detected in the associated Method Blank	C Calculated Value
E Value above quantitation range	H Holding times for preparation or analysis exceeded	
J Analyte detected below quantitation limits	L Analyzed by another laboratory	
M Value exceeds Monthly Ave or MCL or is less than LCL	ND Not Detected at the Reporting Limit	
O Outside the Range of Dilutions	S Spike Recovery outside accepted recovery limits	
X Matrix Effect		

Reviewed by:

Wade Nieuwsma, Assistant Laboratory Manager

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Sample Analysis Report

Company:	Environmental Restoration Group, Inc. 8809 Washington St. NE. Suite 150 Albuquerque, NM 87113	Date Reported	6/1/2016
		Report ID	S1604180002
		(Replaces S1604180001)	
ProjectName:	Midnite Mine	WorkOrder:	S1604180
Lab ID:	S1604180-005	CollectionDate:	3/1/2016
ClientSample ID:	CAL5-0015-SOI-COM-01	DateReceived:	4/13/2016 10:30:00 AM
COC:	WEB	FieldSampler:	RW
		Matrix:	Soil

Comments

Analyses	Result	Units	Qual	RL	Method	Date Analyzed/Init
----------	--------	-------	------	----	--------	--------------------

Radionuclides - Total

Radium 226	15.5	pCi/g	0.2	E901.1 Mod.	04/15/2016 2315	WN
Radium 226 Precision (\pm)	0.5	pCi/g		E901.1 Mod.	04/15/2016 2315	WN

These results apply only to the samples tested.**RL - Reporting Limit**

Qualifiers:

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL or is less than LCL
O	Outside the Range of Dilutions
X	Matrix Effect

C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by another laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

Reviewed by: A. Nieuwsma

Wade Nieuwsma, Assistant Laboratory Manager

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Sample Analysis Report

Company:	Environmental Restoration Group, Inc. 8809 Washington St. NE. Suite 150 Albuquerque, NM 87113	Date Reported	6/1/2016
		Report ID	S1604180002
		(Replaces S1604180001)	
ProjectName:	Midnite Mine	WorkOrder:	S1604180
Lab ID:	S1604180-006	CollectionDate:	3/1/2016
ClientSample ID:	CAL6-0015-SOI-COM-01	DateReceived:	4/13/2016 10:30:00 AM
COC:	WEB	FieldSampler:	RW
		Matrix:	Soil

Comments

Analyses	Result	Units	Qual	RL	Method	Date Analyzed/Init
----------	--------	-------	------	----	--------	--------------------

Radionuclides - Total

Radium 226	16.3	pCi/g	0.2	E901.1 Mod.	04/15/2016 330	WN
Radium 226 Precision (\pm)	0.5	pCi/g		E901.1 Mod.	04/15/2016 330	WN

These results apply only to the samples tested.**RL - Reporting Limit**

Qualifiers:

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL or is less than LCL
O	Outside the Range of Dilutions
X	Matrix Effect

C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by another laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

Reviewed by: A. Nieuwsma

Wade Nieuwsma, Assistant Laboratory Manager

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Sample Analysis Report

Company:	Environmental Restoration Group, Inc. 8809 Washington St. NE. Suite 150 Albuquerque, NM 87113	Date Reported	6/1/2016
		Report ID	S1604180002
		(Replaces S1604180001)	
ProjectName:	Midnite Mine	WorkOrder:	S1604180
Lab ID:	S1604180-007	CollectionDate:	3/1/2016
ClientSample ID:	CORR1-0015-SOI-COM-01	DateReceived:	4/13/2016 10:30:00 AM
COC:	WEB	FieldSampler:	RW
		Matrix:	Soil

Comments

Analyses	Result	Units	Qual	RL	Method	Date Analyzed/Init
----------	--------	-------	------	----	--------	--------------------

Radionuclides - Total

Radium 226	10.4	pCi/g	0.2	E901.1 Mod.	04/15/2016 446	WN
Radium 226 Precision (\pm)	0.4	pCi/g		E901.1 Mod.	04/15/2016 446	WN

These results apply only to the samples tested.**RL - Reporting Limit**

Qualifiers: B Analyte detected in the associated Method Blank
E Value above quantitation range
J Analyte detected below quantitation limits
M Value exceeds Monthly Ave or MCL or is less than LCL
O Outside the Range of Dilutions
X Matrix Effect

C Calculated Value
H Holding times for preparation or analysis exceeded
L Analyzed by another laboratory
ND Not Detected at the Reporting Limit
S Spike Recovery outside accepted recovery limits

Reviewed by: A. Nieuwsma

Wade Nieuwsma, Assistant Laboratory Manager

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Sample Analysis Report

Company: Environmental Restoration Group, Inc.
8809 Washington St. NE. Suite 150
Albuquerque, NM 87113 **Date Reported:** 6/1/2016
ProjectName: Midnite Mine **Report ID:** S1604180002
Lab ID: S1604180-008 **(Replaces** S1604180001)
ClientSample ID: CORR2-0015-SOI-COM-01 **WorkOrder:** S1604180
COC: WEB **CollectionDate:** 3/1/2016
DateReceived: 4/13/2016 10:30:00 AM
FieldSampler: RW
Matrix: Soil

Comments

Analyses	Result	Units	Qual	RL	Method	Date Analyzed/Init
----------	--------	-------	------	----	--------	--------------------

Radionuclides - Total

Radium 226	1.4	pCi/g	0.2	E901.1 Mod.	04/18/2016 1145	WN
Radium 226 Precision (\pm)	0.2	pCi/g		E901.1 Mod.	04/18/2016 1145	WN

These results apply only to the samples tested.**RL - Reporting Limit**

Qualifiers:	B Analyte detected in the associated Method Blank	C Calculated Value
E Value above quantitation range	H Holding times for preparation or analysis exceeded	
J Analyte detected below quantitation limits	L Analyzed by another laboratory	
M Value exceeds Monthly Ave or MCL or is less than LCL	ND Not Detected at the Reporting Limit	
O Outside the Range of Dilutions	S Spike Recovery outside accepted recovery limits	
X Matrix Effect		

Reviewed by:

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Sample Analysis Report

Company: Environmental Restoration Group, Inc.
8809 Washington St. NE. Suite 150
Albuquerque, NM 87113 **Date Reported:** 6/1/2016
Report ID: S1604180002
(Replaces S1604180001)

ProjectName: Midnite Mine **WorkOrder:** S1604180
Lab ID: S1604180-009 **CollectionDate:** 3/1/2016
ClientSample ID: CORR3-0015-SOI-COM-01 **DateReceived:** 4/13/2016 10:30:00 AM
COC: WEB **FieldSampler:** RW
Matrix: Soil

Comments

Analyses	Result	Units	Qual	RL	Method	Date Analyzed/Init
Radionuclides - Total						
Radium 226	11.8	pCi/g		0.2	E901.1 Mod.	04/15/2016 717 WN
Radium 226 Precision (\pm)	0.4	pCi/g			E901.1 Mod.	04/15/2016 717 WN

These results apply only to the samples tested.**RL - Reporting Limit**

Qualifiers: B Analyte detected in the associated Method Blank
E Value above quantitation range
J Analyte detected below quantitation limits
M Value exceeds Monthly Ave or MCL or is less than LCL
O Outside the Range of Dilutions
X Matrix Effect

C Calculated Value
H Holding times for preparation or analysis exceeded
L Analyzed by another laboratory
ND Not Detected at the Reporting Limit
S Spike Recovery outside accepted recovery limits

Reviewed by: A. Nieuwsma

Wade Nieuwsma, Assistant Laboratory Manager

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Sample Analysis Report

Company:	Environmental Restoration Group, Inc. 8809 Washington St. NE. Suite 150 Albuquerque, NM 87113	Date Reported	6/1/2016
		Report ID	S1604180002
		(Replaces S1604180001)	
ProjectName:	Midnite Mine	WorkOrder:	S1604180
Lab ID:	S1604180-010	CollectionDate:	3/1/2016
ClientSample ID:	CORR4-0015-SOI-COM-01	DateReceived:	4/13/2016 10:30:00 AM
COC:	WEB	FieldSampler:	RW
		Matrix:	Soil

Comments

Analyses	Result	Units	Qual	RL	Method	Date Analyzed/Init
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Radionuclides - Total

Radium 226	1.3	pCi/g	0.2	E901.1 Mod.	04/18/2016 1417	WN
Radium 226 Precision (\pm)	0.2	pCi/g		E901.1 Mod.	04/18/2016 1417	WN

These results apply only to the samples tested.**RL - Reporting Limit**

Qualifiers:	B Analyte detected in the associated Method Blank	C Calculated Value
E Value above quantitation range	H Holding times for preparation or analysis exceeded	
J Analyte detected below quantitation limits	L Analyzed by another laboratory	
M Value exceeds Monthly Ave or MCL or is less than LCL	ND Not Detected at the Reporting Limit	
O Outside the Range of Dilutions	S Spike Recovery outside accepted recovery limits	
X Matrix Effect		

Reviewed by:

Wade Nieuwsma, Assistant Laboratory Manager

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ANALYTICAL QC SUMMARY REPORT

CLIENT: Environmental Restoration Group, Inc.
Work Order: S1604180
Project: Midnite Mine

Date: 6/1/2016**Report ID:** S1604180002

(Replaces S1604180001)

Radium By Gamma Spectroscopy in Soil

Sample Type **MBLK**

Units: pCi/g

MB-11626 (04/14/16 18:36)	RunNo: 133096	PrepDate: 03/14/16 10:13	BatchID: 11626				
Analyte	Result	RL	Spike	Ref Samp	%REC	% Rec Limits	Qual
Radium 226	ND	0.2					

Radium By Gamma Spectroscopy in Soil

Sample Type **LCS**

Units: pCi/g

ROCKYFLATS (04/18/16 18:05)	RunNo: 133096	PrepDate: 03/14/16 10:13	BatchID: 11626				
Analyte	Result	RL	Spike	Ref Samp	%REC	% Rec Limits	Qual
Radium 226	1.2	0.2	1.15		103	70 - 130	
UTS-4-CAN (04/18/16 15:33)	RunNo: 133096	PrepDate: 03/14/16 10:13	BatchID: 11626				
Analyte	Result	RL	Spike	Ref Samp	%REC	% Rec Limits	Qual
Radium 226	965	0.2	971		99.3	70 - 130	

Qualifiers: B Analyte detected in the associated Method Blank
 H Holding times for preparation or analysis exceeded
 L Analyzed by another laboratory
 O Outside the Range of Dilutions
 S Spike Recovery outside accepted recovery limits

E Value above quantitation range
 J Analyte detected below quantitation limits
 ND Not Detected at the Reporting Limit
 R RPD outside accepted recovery limits
 X Matrix Effect

Instrument Batch:

16-7

Radium Analysis by Gamma Spectroscopy

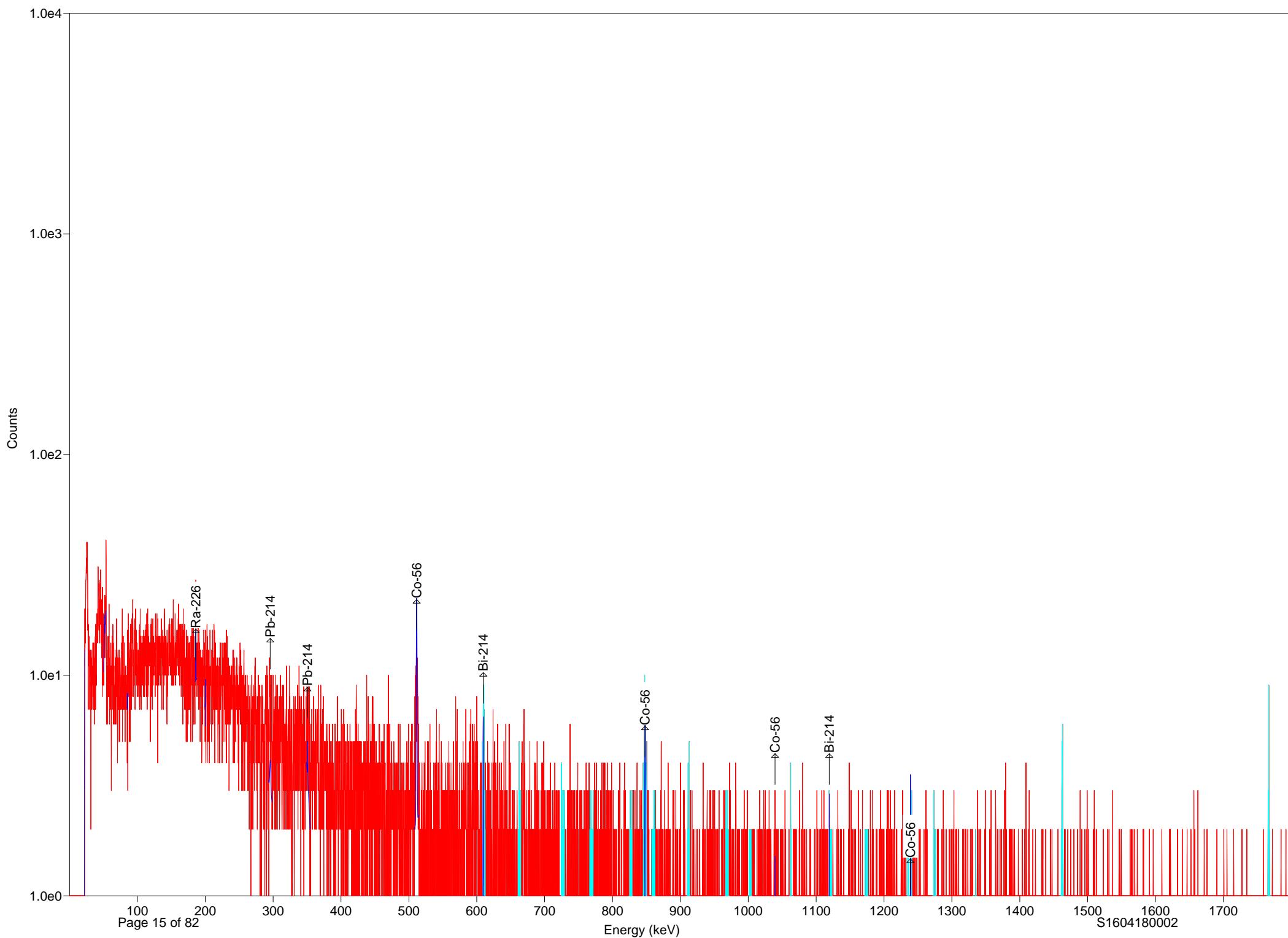
Omega Run 133096

SampID	SampID	SampID	Analyte	Text Rslt	Counts	Error	Time	Result	95% CI	Weight	Samp Type	Prep
MB-11626	4/14/16 18:36	RAD_GAMMA_RA_S	Radium 226		16	13	4500	-0.10	0.11	150	MBLK	11626
S1604180-001A	4/14/16 21:10	RAD_GAMMA_RA_S	Radium 226	18.0 ± 0.5	5789	84	4500	18.00	0.51	203.4	SAMP	11626
S1604180-002A	4/14/16 22:26	RAD_GAMMA_RA_S	Radium 226	26.5 ± 0.6	8077	99	4500	26.49	0.64	193.23	SAMP	11626
S1604180-003A	4/14/16 23:42	RAD_GAMMA_RA_S	Radium 226	12.4 ± 0.4	3702	67	4500	12.38	0.44	188.5	SAMP	11626
S1604180-006A	4/15/16 3:30	RAD_GAMMA_RA_S	Radium 226	16.3 ± 0.5	4840	77	4500	16.30	0.51	187.53	SAMP	11626
S1604180-007A	4/15/16 4:46	RAD_GAMMA_RA_S	Radium 226	10.4 ± 0.4	2883	60	4500	10.43	0.43	173.66	SAMP	11626
S1604180-009A	4/15/16 7:17	RAD_GAMMA_RA_S	Radium 226	11.8 ± 0.4	3812	69	4500	11.78	0.42	203.97	SAMP	11626
S1604180-010A	4/15/16 8:33	RAD_GAMMA_RA_S	Radium 226	1.3 ± 0.2	311	23	4500	1.26	0.21	137.81	SAMP	11626
S1604180-004A	4/15/16 21:59	RAD_GAMMA_RA_S	Radium 226	3.4 ± 0.3	998	38	4500	3.36	0.26	181.57	SAMP	11626
S1604180-005A	4/15/16 23:15	RAD_GAMMA_RA_S	Radium 226	15.5 ± 0.5	4871	77	4500	15.51	0.48	198.38	SAMP	11626
S1604180-008A	4/18/16 11:45	RAD_GAMMA_RA_S	Radium 226	1.4 ± 0.2	390	25	4500	1.39	0.19	160.25	SAMP	11626
UTS-4-CAN	4/18/16 15:33	RAD_GAMMA_RA_S	Radium 226		7612	98	4500	964.64	24.34	5	LCS	11626
ROCKYFLATS	4/18/16 18:05	RAD_GAMMA_RA_S	Radium 226		178	20	4500	1.19	0.33	74.56	LCS	11626

Reviewed By

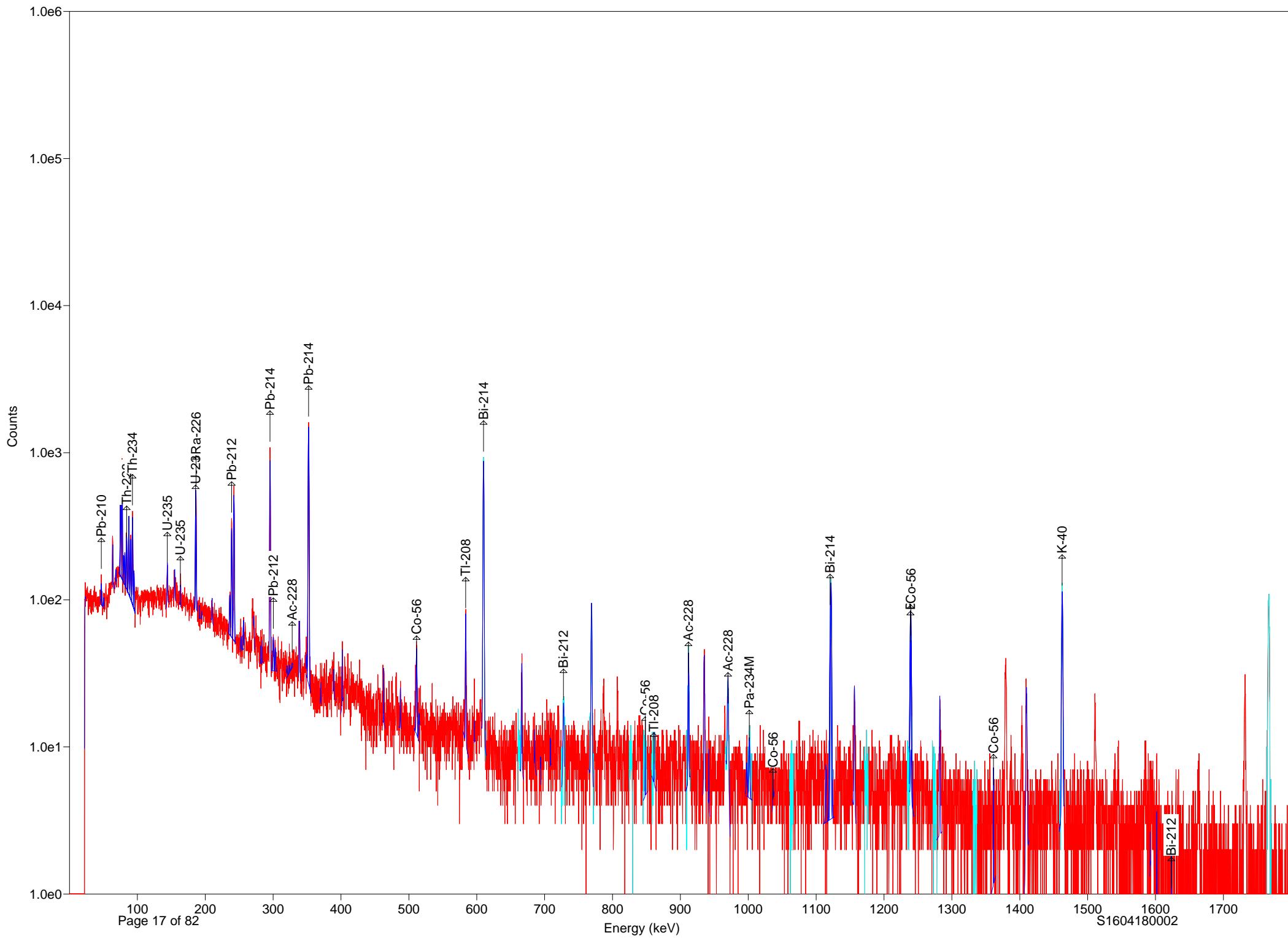

 4/18/16
 S1604180002

MB-11626	MBLK	RAD_GAMMA_I	4/14/2016 18:36	Radium 226	-9.86E-02 pCi/g		1	0 MB-11626
RADSTD-15-3	CCV	RAD_GAMMA_I	4/18/2016 16:49	Radium 226	38.43795 pCi/g		1	0 RADSTD-15-3
ROCKYFLATS	LCS	RAD_GAMMA_I	4/18/2016 18:05	Radium 226	1.185507 pCi/g		1	0 ROCKYFLATS
S1604180-001A	SAMP	RAD_GAMMA_I	4/14/2016 21:10	Radium 226	18.00445 pCi/g	18.0 ± 0.5	1	1 S1604180-001A
S1604180-002A	SAMP	RAD_GAMMA_I	4/14/2016 22:26	Radium 226	26.4936 pCi/g	26.5 ± 0.6	1	1 S1604180-002A
S1604180-003A	SAMP	RAD_GAMMA_I	4/14/2016 23:42	Radium 226	12.37596 pCi/g	12.4 ± 0.4	1	1 S1604180-003A
S1604180-004A	SAMP	RAD_GAMMA_I	4/15/2016 21:59	Radium 226	3.363217 pCi/g	3.4 ± 0.3	1	1 S1604180-004A
S1604180-005A	SAMP	RAD_GAMMA_I	4/15/2016 23:15	Radium 226	15.51275 pCi/g	15.5 ± 0.5	1	1 S1604180-005A
S1604180-006A	SAMP	RAD_GAMMA_I	4/15/2016 3:30	Radium 226	16.30499 pCi/g	16.3 ± 0.5	1	1 S1604180-006A
S1604180-007A	SAMP	RAD_GAMMA_I	4/15/2016 4:46	Radium 226	10.4298 pCi/g	10.4 ± 0.4	1	1 S1604180-007A
S1604180-008A	SAMP	RAD_GAMMA_I	4/18/2016 11:45	Radium 226	1.394176 pCi/g	1.4 ± 0.2	1	1 S1604180-008A
S1604180-009A	SAMP	RAD_GAMMA_I	4/15/2016 7:17	Radium 226	11.7808 pCi/g	11.8 ± 0.4	1	1 S1604180-009A
S1604180-010A	SAMP	RAD_GAMMA_I	4/15/2016 8:33	Radium 226	1.256083 pCi/g	1.3 ± 0.2	1	1 S1604180-010A
UTS-4-CAN	LCS	RAD_GAMMA_I	4/18/2016 15:33	Radium 226	964.639 pCi/g		1	0 UTS-4-CAN



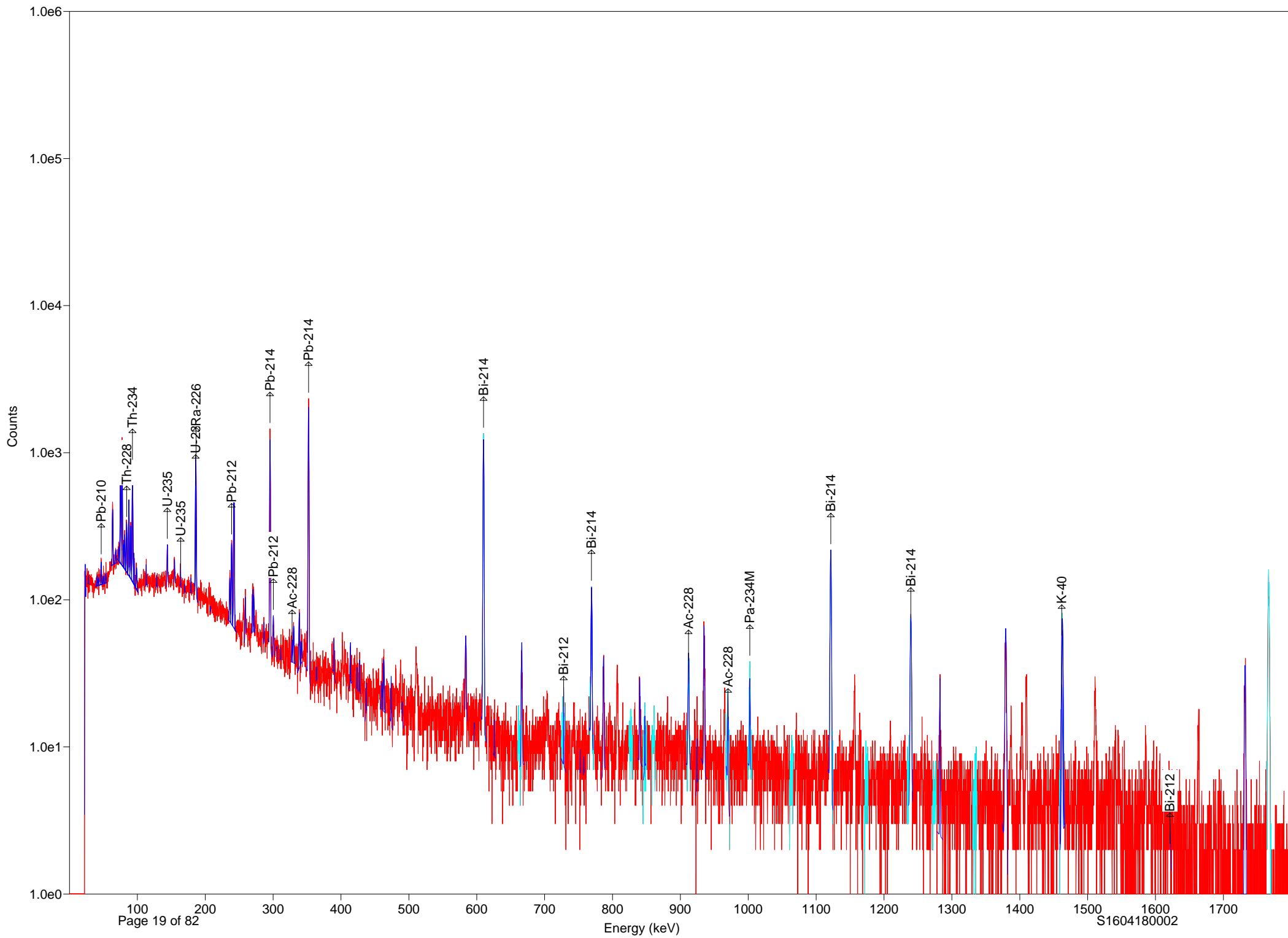
MB-11626.Rpt

Detector #1	ACQ	14-Apr-2016 at 18:36:49	RT = 4504.7	LT = 4500.0
Rad	Chem	1		
MB-105				
ROI#	RANGE(keV)	GROSS	NET	+/-
	μCi			
1	607.80 612.63 0.0000 0.0000	77	16	13
2	660.21 665.47 0.0000 0.0000	33	16	8
3	724.23 729.94	43	-11	13 Could not properly fit the peak.
4	766.11 772.03 0.0000 0.0001	35	-2	11 766.77 2.63 2.76 Bi-214 768.36
5	823.77 829.47 0.0197 0.0315	23	5	8 825.53 3.07 3.20 Co-60 826.28
6	844.60 850.30 0.0000 0.0000	77	27	14 846.94 0.90 1.31 Co-56 846.77
7	857.32 863.02 0.0000 0.0000	32	5	9 860.61 1.75 1.89 Tl-208 860.56
8	908.62 914.32 0.0000 0.0000	30	25	6 912.99 0.66 1.28 Ac-228 911.20
9	965.83 971.97 0.0000 0.0000	36	-12	13 966.93 0.33 0.53 Ac-228 968.97
10	998.71 1004.85	22	-7	10 Could not properly fit the peak.
11	1060.09 1066.23 match!	21	2	8 1061.84 0.27 0.70 No close library
12	1118.17 1124.31 0.0000 0.0000	31	12	9 1118.83 0.33 0.53 Bi-214 1120.29
13	1170.34 1176.48 0.0000 0.0000	16	1	7 1171.65 0.44 0.70 Co-60 1173.24
14	1233.24 1241.13 0.0000 0.0000	27	-4	12 1240.03 0.22 0.35 Co-56 1238.28
15	1270.72 1277.29 match!	17	1	8 1272.69 3.18 3.37 No close library
16	1329.88 1336.46	13	-13	9 Could not properly fit the peak.
17	1457.64 1464.65 0.0002 0.0000	38	38	6 1462.21 0.27 1.46 K-40 1461.00
18	1762.38 1769.83 0.0001 0.0000	25	13	8 1765.65 0.25 0.63 Bi-214 1764.49



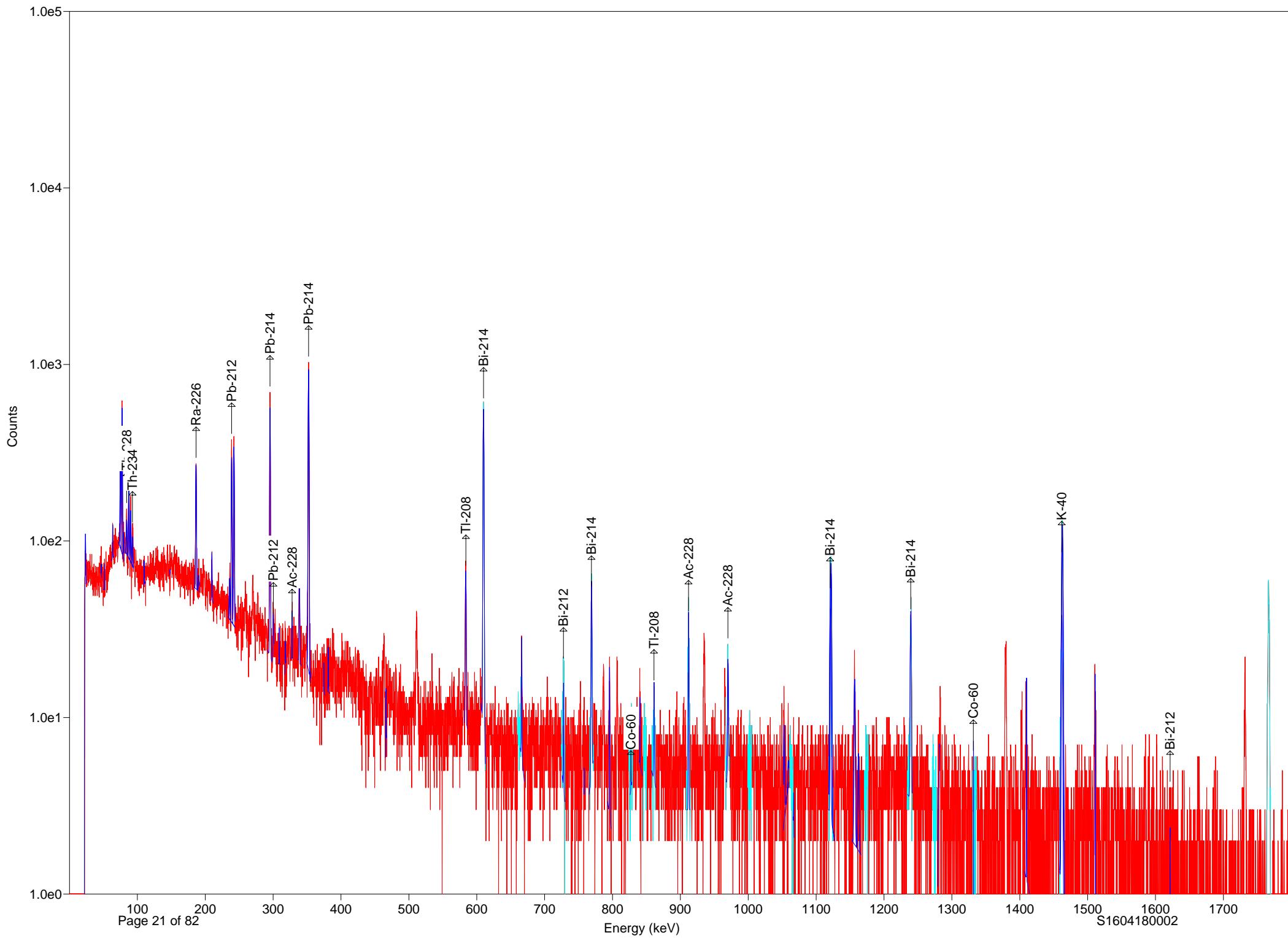
S1604180-001A.Rpt

Detector #1	ACQ	14-Apr-2016 at 21:10:41	RT = 4513.0	LT = 4500.0					
Rad	Chem	1							
S1604180-001A									
ROI#	RANGE(keV)	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY	(keV)
μCi	+/-								
1	607.80 612.63 0.0028 0.0000	6268	5789	84	609.76	1.30	1.99	Bi-214	609.31
2	660.21 665.47 0.0000 0.0000	276	-49	31	660.87	0.23	0.37	Cs-137	661.66
3	724.23 729.94 0.0002 0.0001	304	47	30	727.69	1.29	1.87	Bi-212	727.00
4	766.11 772.03 0.0030 0.0002	826	527	40	768.84	1.44	2.05	Bi-214	768.36
5	823.77 829.47 0.2284 0.0945	216	58	24	826.84	0.25	0.40	Co-60	826.28
6	844.60 850.30 0.0000 0.0000	219	70	24	848.07	0.27	1.74	Co-56	846.77
7	857.32 863.02 0.0001 0.0001	245	47	27	858.60	3.34	3.93	Tl-208	860.56
8	908.62 914.32 0.0003 0.0000	441	234	30	911.73	1.23	2.15	Ac-228	911.20
9	965.83 971.97 0.0004 0.0001	372	169	30	969.58	1.85	2.74	Ac-228	968.97
10	998.71 1004.85 0.0012 0.0013	241	28	29	1001.74	1.13	1.70	Pa-234M	1001.03
11	1060.09 1066.23 match!	156	1	24	1063.38	0.24	0.39	No close library	
12	1118.17 1124.31 0.0033 0.0001	1357	1164	43	1121.05	1.78	2.59	Bi-214	1120.29
13	1170.34 1176.48 0.0000 0.0000	187	-2	26	1173.80	0.28	0.56	Co-60	1173.24
14	1233.24 1241.13 0.0003 0.0000	688	466	40	1238.86	1.68	2.46	Co-56	1238.28
15	1270.72 1277.29 match!	165	-21	27	1273.13	1.53	1.67	No close library	
16	1329.88 1336.46 0.0000 0.0000	111	-29	23	1332.73	0.22	0.35	Co-60	1332.50
17	1457.64 1464.65 0.0053 0.0002	1149	1006	40	1461.74	1.55	2.87	K-40	1461.00
18	1762.38 1769.83 0.0044 0.0002	1084	961	39	1765.57	2.13	3.05	Bi-214	1764.49



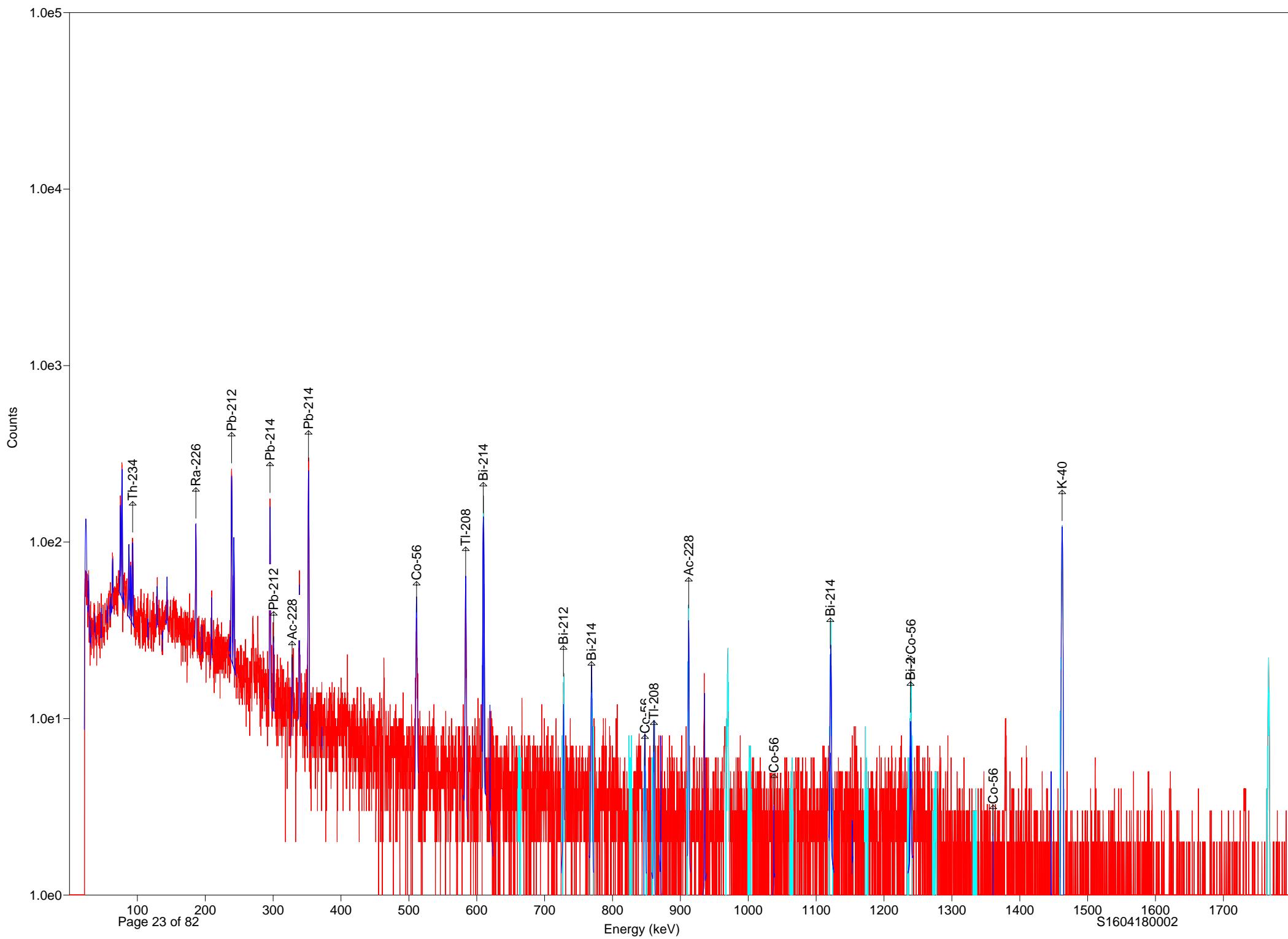
S1604180-002A.Rpt

Detector #1	ACQ	14-Apr-2016 at 22:26:36	RT = 4515.5	LT = 4500.0					
Rad	Chem	1							
S1604180-002A									
ROI#	RANGE(keV)	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY	(keV)
μCi	+/-								
1	607.80 612.63 0.0038 0.0000	8710	8077	99	609.75	1.28	1.90	Bi-214	609.31
2	660.21 665.47 0.0000 0.0000	333	-213	38	661.30	0.25	0.39	Cs-137	661.66
3	724.23 729.94 0.0001 0.0001	365	32	34	726.69	0.27	0.49	Bi-212	727.00
4	766.11 772.03 0.0043 0.0003	1127	754	46	768.89	1.45	2.10	Bi-214	768.36
5	823.77 829.47 0.0630 0.1221	300	16	31	827.17	0.38	0.58	Co-60	826.28
6	844.60 850.30 0.0000 0.0000	286	38	30	847.55	0.46	0.72	Co-56	846.77
7	857.32 863.02 0.0002 0.0001	284	72	28	861.17	0.45	1.12	Tl-208	860.56
8	908.62 914.32 0.0002 0.0000	470	200	33	911.86	1.89	2.28	Ac-228	911.20
9	965.83 971.97 0.0002 0.0001	323	86	31	969.30	0.98	2.96	Ac-228	968.97
10	998.71 1004.85 0.0076 0.0014	410	173	32	1001.59	0.84	2.22	Pa-234M	1001.03
11	1060.09 1066.23 match!	193	14	26	1063.45	0.47	0.94	No close library	
12	1118.17 1124.31 0.0048 0.0001	1929	1687	51	1121.04	1.62	2.63	Bi-214	1120.29
13	1170.34 1176.48 0.0000 0.0000	165	25	23	1172.29	0.70	0.96	Co-60	1173.24
14	1233.24 1241.13 0.0004 0.0000	821	617	40	1238.96	1.83	2.86	Co-56	1238.28
15	1270.72 1277.29 match!	144	56	20	1272.14	4.62	4.78	No close library	
16	1329.88 1336.46 0.0000 0.0000	133	-7	23	1335.36	0.22	0.35	Co-60	1332.50
17	1457.64 1464.65 0.0034 0.0002	841	654	38	1461.74	1.78	2.73	K-40	1461.00
18	1762.38 1769.83 0.0060 0.0002	1431	1332	42	1765.45	2.04	3.15	Bi-214	1764.49



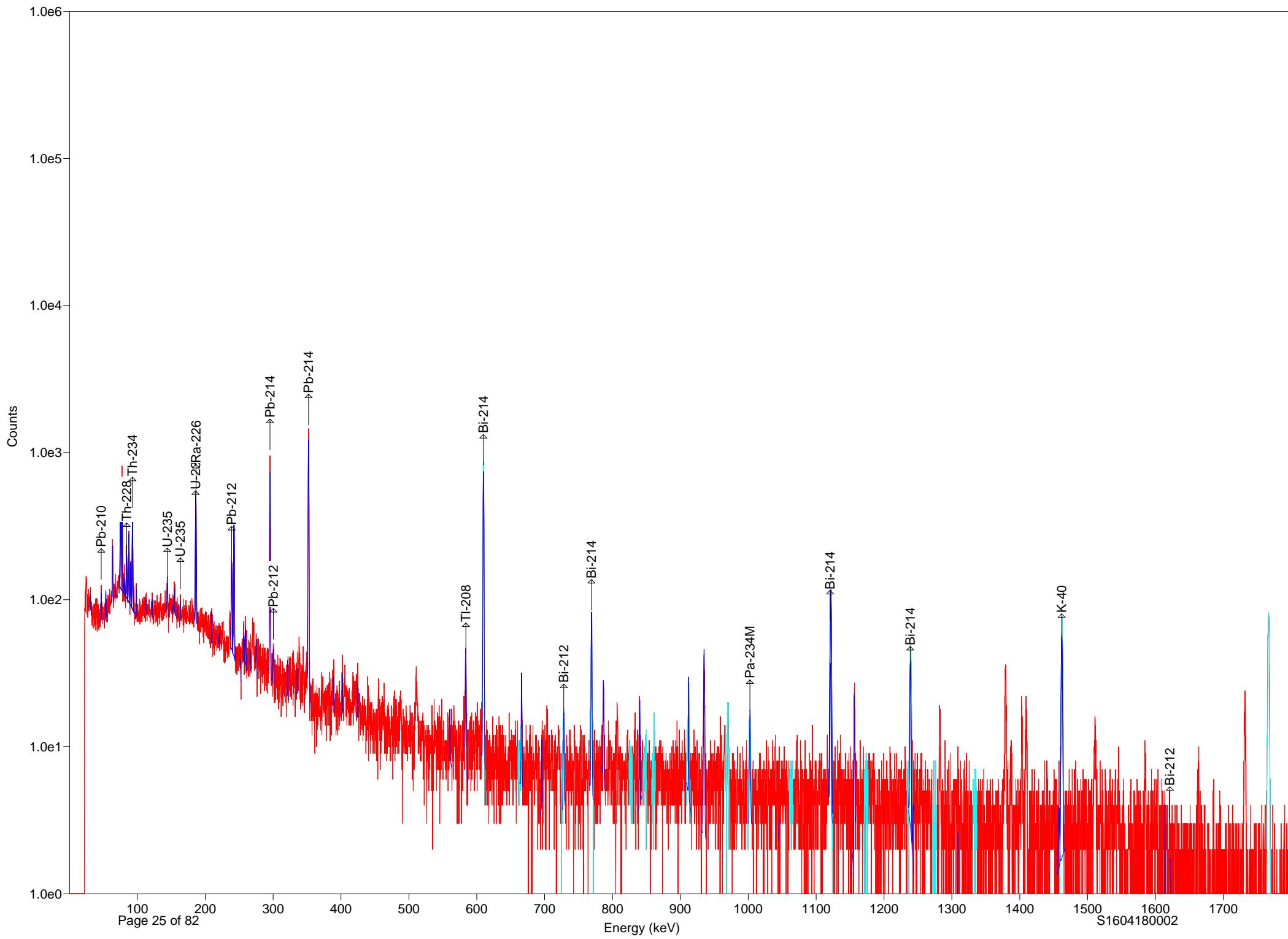
S1604180-003A.Rpt

Detector #1	ACQ	14-Apr-2016 at 23:42:33	RT = 4510.1	LT = 4500.0					
Rad	Chem	1							
S1604180-003A									
ROI#	RANGE(keV)	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY	(keV)
μCi	+/-								
1	607.80 612.63 0.0018 0.0000	3986	3702	67	609.74	1.35	1.95	Bi-214	609.31
2	660.21 665.47 0.0000 0.0000	240	-98	31	660.87	0.22	0.35	Cs-137	661.66
3	724.23 729.94 0.0003 0.0001	247	85	25	727.43	0.50	1.69	Bi-212	727.00
4	766.11 772.03 0.0018 0.0002	537	318	33	768.83	1.24	2.17	Bi-214	768.36
5	823.77 829.47 0.0000 0.0945	158	-22	24	827.28	0.25	0.39	Co-60	826.28
6	844.60 850.30 0.0000 0.0000	171	45	22	846.66	0.43	1.49	Co-56	846.77
7	857.32 863.02 0.0001 0.0001	209	47	24	860.80	0.47	1.84	Tl-208	860.56
8	908.62 914.32 0.0003 0.0000	375	258	25	911.70	0.92	2.38	Ac-228	911.20
9	965.83 971.97 0.0001 0.0001	292	65	30	969.67	0.98	1.59	Ac-228	968.97
10	998.71 1004.85 0.0000 0.0011	159	-20	25	1001.56	0.25	0.39	Pa-234M	1001.03
11	1060.09 1066.23 match!	143	-12	24	1061.19	0.27	0.48	No close library	
12	1118.17 1124.31 0.0021 0.0001	869	748	34	1121.06	1.79	2.61	Bi-214	1120.29
13	1170.34 1176.48 0.0000 0.0000	123	-17	22	1172.53	0.26	0.44	Co-60	1173.24
14	1233.24 1241.13 0.0002 0.0000	449	307	32	1238.90	1.96	2.62	Co-56	1238.28
15	1270.72 1277.29 match!	112	9	20	1271.59	0.22	0.35	No close library	
16	1329.88 1336.46 0.0000 0.0000	95	-14	20	1333.61	1.59	2.45	Co-60	1332.50
17	1457.64 1464.65 0.0065 0.0002	1308	1242	39	1461.71	1.76	2.63	K-40	1461.00
18	1762.38 1769.83 0.0025 0.0001	609	556	28	1765.58	2.17	3.40	Bi-214	1764.49



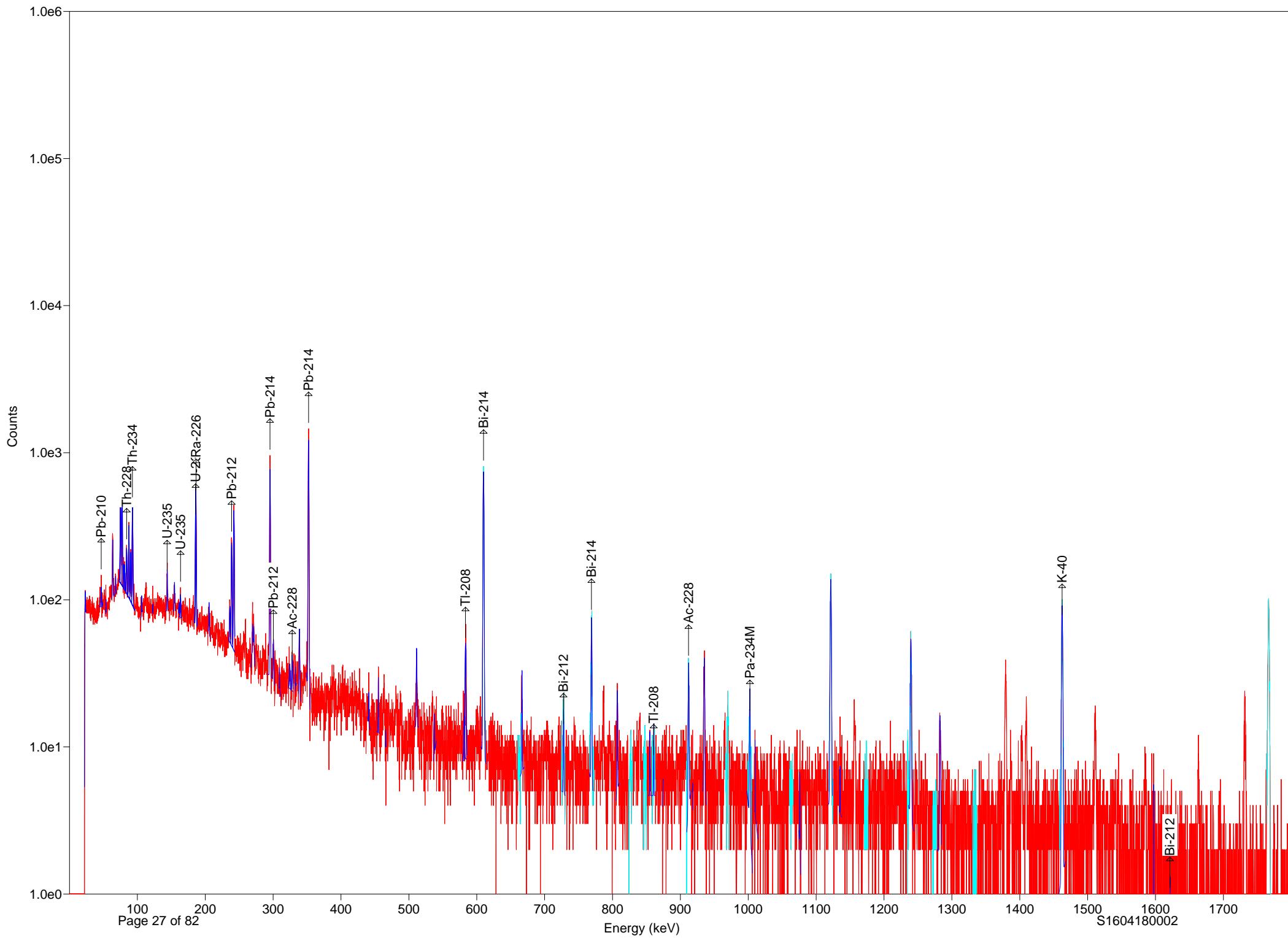
S1604180-004A.Rpt

Detector #1	ACQ	15-Apr-2016 at 21:59:20	RT = 4506.8	LT = 4500.0					
Rad	Chem	1							
S1604180-004A									
ROI#	RANGE(keV)	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY	(keV)
μCi	+/-								
1	607.80 612.63 0.0005 0.0000	1174	998	38	609.70	1.43	1.96	Bi-214	609.31
2	660.21 665.47 0.0000 0.0000	103	-22	19	660.87	0.22	0.35	Cs-137	661.66
3	724.23 729.94 0.0002 0.0001	166	62	20	727.81	0.92	1.69	Bi-212	727.00
4	766.11 772.03 0.0005 0.0001	172	79	20	768.90	1.71	2.18	Bi-214	768.36
5	823.77 829.47 0.0039 0.0709	96	1	18	827.50	0.22	0.35	Co-60	826.28
6	844.60 850.30 0.0000 0.0000	96	10	17	846.99	0.90	1.59	Co-56	846.77
7	857.32 863.02 0.0001 0.0000	136	46	19	861.01	0.98	1.66	Tl-208	860.56
8	908.62 914.32 0.0003 0.0000	318	241	22	911.81	1.15	2.51	Ac-228	911.20
9	965.83 971.97 0.0002 0.0001	240	95	25	969.59	0.69	1.97	Ac-228	968.97
10	998.71 1004.85 0.0005 0.0008	93	11	18	1000.91	0.25	0.39	Pa-234M	1001.03
11	1060.09 1066.23 match!	71	-11	17	1064.47	0.26	0.75	No close library	
12	1118.17 1124.31 0.0006 0.0001	285	222	21	1121.05	0.85	3.03	Bi-214	1120.29
13	1170.34 1176.48 0.0000 0.0000	81	8	16	1172.09	0.22	0.35	Co-60	1173.24
14	1233.24 1241.13 0.0001 0.0000	204	124	23	1238.96	1.71	2.55	Co-56	1238.28
15	1270.72 1277.29 match!	67	10	15	1274.22	2.63	2.76	No close library	
16	1329.88 1336.46 0.0000 0.0000	48	-4	14	1334.71	0.22	0.35	Co-60	1332.50
17	1457.64 1464.65 0.0059 0.0002	1154	1121	35	1461.66	1.80	2.93	K-40	1461.00
18	1762.38 1769.83 0.0008 0.0001	189	166	16	1765.55	0.92	2.70	Bi-214	1764.49



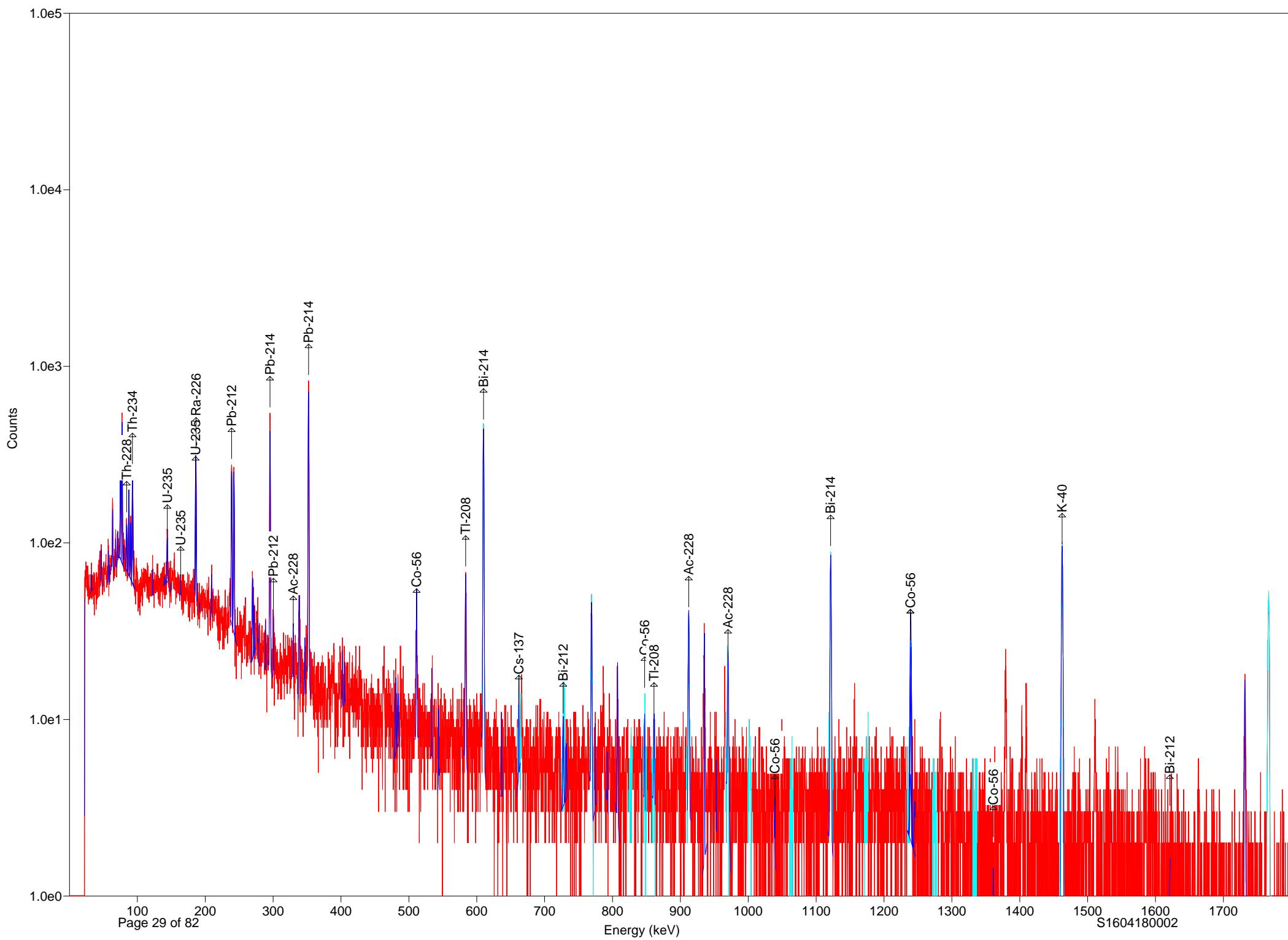
S1604180-005A.Rpt

Detector #1	ACQ	15-Apr-2016 at 23:15:08	RT = 4511.2	LT = 4500.0				
Rad	Chem	1						
S1604180-005A								
ROI#	RANGE(keV)	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
μCi	+/-							
1	607.80 612.63 0.0023 0.0000	5281	4871	77	609.68	1.28	1.94	Bi-214 609.31
2	660.21 665.47 0.0002 0.0001	235	-48	29	Could not properly fit the peak.			
3	724.23 729.94 0.0002 0.0001	236	60	25	727.81	0.90	2.05	Bi-212 727.00
4	766.11 772.03 0.0026 0.0002	714	457	37	768.87	1.18	1.97	Bi-214 768.36
5	823.77 829.47 0.0158 0.0984	189	4	25	824.97	0.40	0.55	Co-60 826.28
6	844.60 850.30 0.0000 0.0000	194	-22	27	849.64	0.22	0.35	Co-56 846.77
7	857.32 863.02 0.0001 0.0001	197	53	23	861.20	0.95	1.37	Tl-208 860.56
8	908.62 914.32 0.0002 0.0000	311	149	26	911.37	1.49	2.49	Ac-228 911.20
9	965.83 971.97 0.0001 0.0001	260	57	28	969.78	1.47	1.77	Ac-228 968.97
10	998.71 1004.85 0.0041 0.0010	208	92	23	1001.72	1.57	2.72	Pa-234M 1001.03
11	1060.09 1066.23 match!	131	5	22	1062.28	2.85	2.98	No close library
12	1118.17 1124.31 0.0030 0.0001	1177	1042	39	1120.99	1.67	2.66	Bi-214 1120.29
13	1170.34 1176.48 0.0000 0.0000	134	3	22	1172.53	1.64	1.84	Co-60 1173.24
14	1233.24 1241.13 0.0002 0.0000	523	295	38	1238.77	1.91	2.71	Co-56 1238.28
15	1270.72 1277.29 match!	92	14	18	1273.13	0.24	0.39	No close library
16	1329.88 1336.46 0.0000 0.0000	106	28	18	1333.39	1.75	2.26	Co-60 1332.50
17	1457.64 1464.65 0.0032 0.0002	697	598	32	1461.64	1.65	2.92	K-40 1461.00
18	1762.38 1769.83 0.0037 0.0002	913	820	35	1765.40	2.16	3.20	Bi-214 1764.49



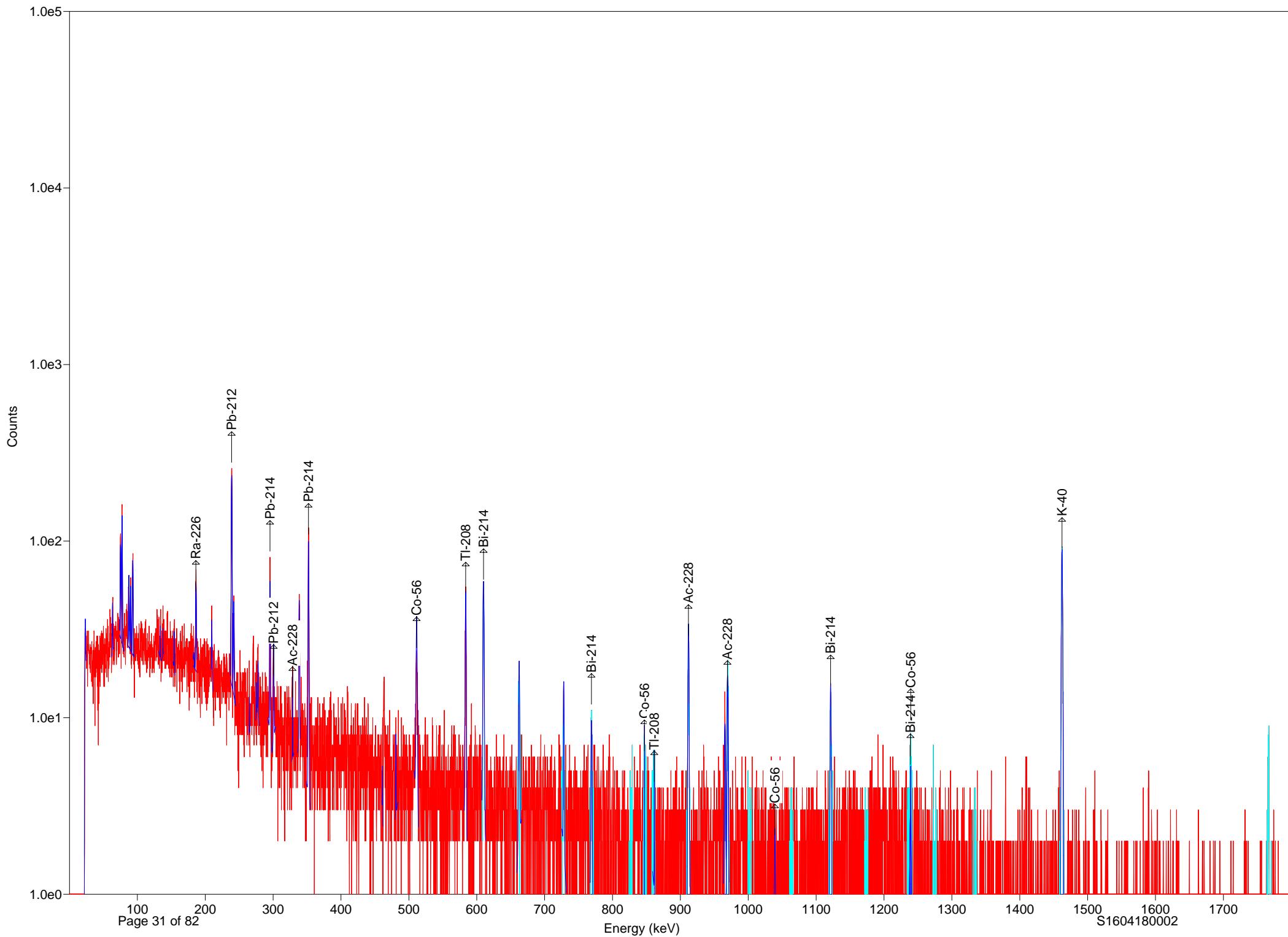
S1604180-006A.Rpt

Detector #1	ACQ	15-Apr-2016	at	3:30:08	RT =	4511.8	LT =	4500.0
Rad	Chem	1						
S1604180-006A								
ROI#	RANGE(keV)	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
μCi	+/-							
1	607.80 612.63 0.0023 0.0000	5273	4840	77	609.74	1.34	1.94	Bi-214 609.31
2	660.21 665.47	232	-85	30	Could not properly fit the peak.			
3	724.23 729.94 0.0003 0.0001	275	81	27	727.91	0.91	1.77	Bi-212 727.00
4	766.11 772.03 0.0024 0.0002	693	422	37	768.90	1.08	2.09	Bi-214 768.36
5	823.77 829.47 0.1811 0.0866	181	46	22	826.95	0.37	0.54	Co-60 826.28
6	844.60 850.30 0.0000 0.0000	183	70	21	847.69	0.78	1.39	Co-56 846.77
7	857.32 863.02 0.0001 0.0001	215	57	24	860.90	0.58	1.91	Tl-208 860.56
8	908.62 914.32 0.0002 0.0000	358	200	27	911.73	1.36	2.03	Ac-228 911.20
9	965.83 971.97 0.0002 0.0001	277	84	28	969.57	1.34	2.13	Ac-228 968.97
10	998.71 1004.85 0.0045 0.0012	265	101	27	1001.79	1.02	1.29	Pa-234M 1001.03
11	1060.09 1066.23 match!	158	-2	24	1064.69	0.26	0.66	No close library
12	1118.17 1124.31 0.0030 0.0001	1234	1070	41	1121.05	1.71	2.50	Bi-214 1120.29
13	1170.34 1176.48 0.0000 0.0000	138	-7	23	1173.19	0.88	1.01	Co-60 1173.24
14	1233.24 1241.13 0.0003 0.0000	585	369	38	1238.84	1.44	2.52	Co-56 1238.28
15	1270.72 1277.29 match!	107	-7	21	1271.81	0.27	0.77	No close library
16	1329.88 1336.46 0.0000 0.0000	77	-6	18	1332.51	2.19	2.32	Co-60 1332.50
17	1457.64 1464.65 0.0040 0.0002	875	754	36	1461.52	1.67	3.05	K-40 1461.00
18	1762.38 1769.83 0.0039 0.0002	959	860	36	1765.44	1.68	3.19	Bi-214 1764.49



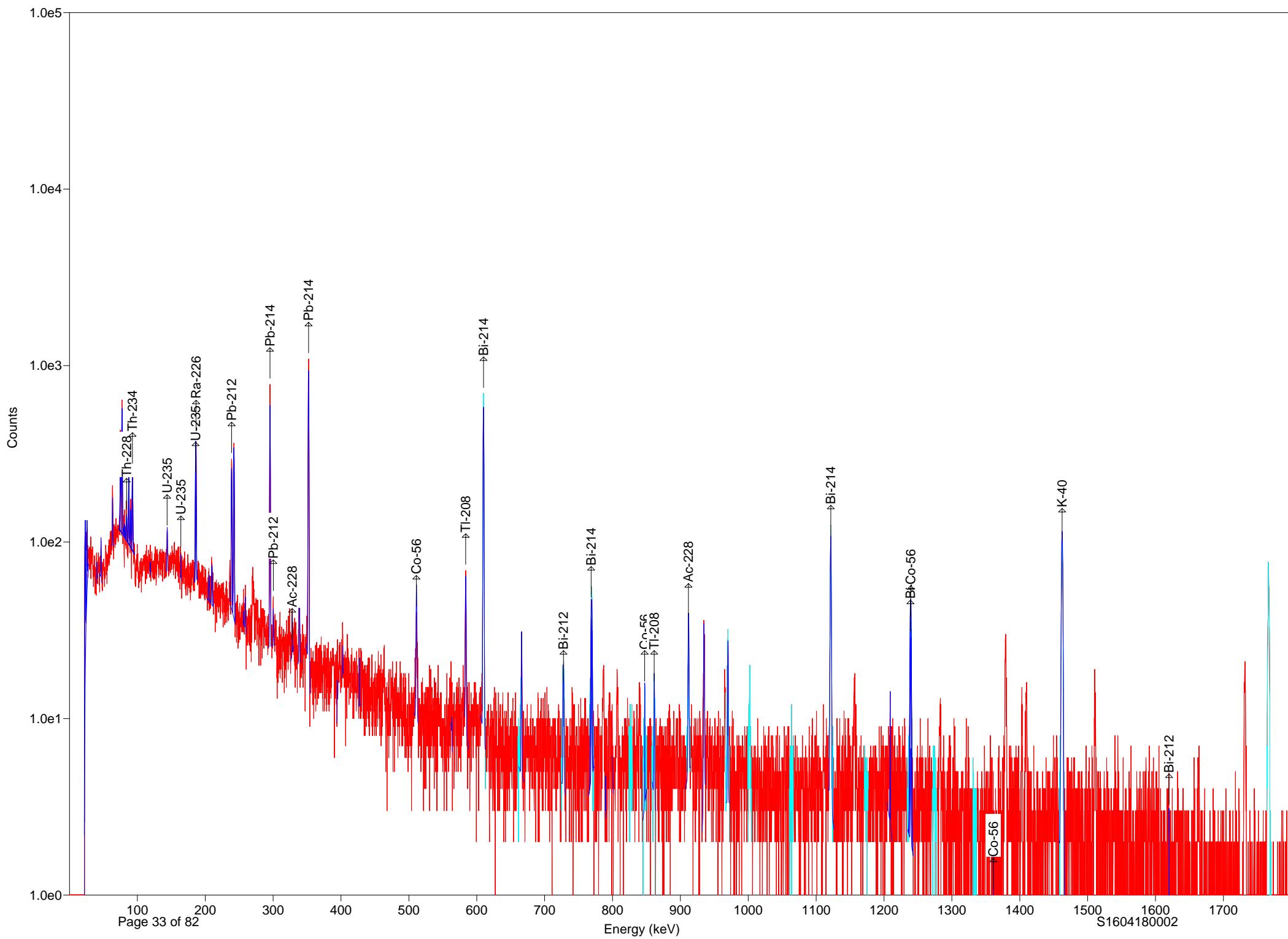
S1604180-007A.Rpt

Detector #1	ACQ	15-Apr-2016	at	4:46:01	RT =	4509.3	LT =	4500.0
Rad	Chem	1						
S1604180-007A								
ROI#	RANGE(keV)	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
	μCi	+/-						
1	607.80 612.63 0.0014 0.0000	3178	2883	60	609.70	1.27	1.93	Bi-214 609.31
2	660.21 665.47 0.0000 0.0000	247	-32	29	661.96	0.26	0.42	Cs-137 661.66
3	724.23 729.94 0.0003 0.0001	237	84	24	728.02	0.31	0.96	Bi-212 727.00
4	766.11 772.03 0.0014 0.0002	415	247	29	768.86	1.37	2.25	Bi-214 768.36
5	823.77 829.47 0.0000 0.0827	135	0	21	827.17	0.40	0.55	Co-60 826.28
6	844.60 850.30 0.0000 0.0000	169	11	23	847.05	0.84	1.02	Co-56 846.77
7	857.32 863.02 0.0001 0.0001	157	44	20	861.70	0.54	0.77	Tl-208 860.56
8	908.62 914.32 0.0003 0.0000	382	247	26	911.75	1.31	2.25	Ac-228 911.20
9	965.83 971.97 0.0002 0.0001	275	72	29	969.58	1.67	2.00	Ac-228 968.97
10	998.71 1004.85 0.0020 0.0009	147	45	20	1000.97	0.70	1.92	Pa-234M 1001.03
11	1060.09 1066.23 match!	93	6	18	1063.82	0.22	0.35	No close library
12	1118.17 1124.31 0.0017 0.0001	742	592	34	1120.89	1.58	2.52	Bi-214 1120.29
13	1170.34 1176.48 0.0000 0.0000	123	31	19	1175.82	0.23	0.38	Co-60 1173.24
14	1233.24 1241.13 0.0002 0.0000	329	218	28	1239.01	1.85	2.71	Co-56 1238.28
15	1270.72 1277.29 match!	97	19	18	1271.64	1.42	1.62	No close library
16	1329.88 1336.46 0.0000 0.0000	73	-25	19	1330.54	4.16	4.30	Co-60 1332.50
17	1457.64 1464.65 0.0047 0.0002	925	892	32	1461.64	1.81	3.02	K-40 1461.00
18	1762.38 1769.83 0.0022 0.0001	539	486	27	1765.49	2.16	3.09	Bi-214 1764.49



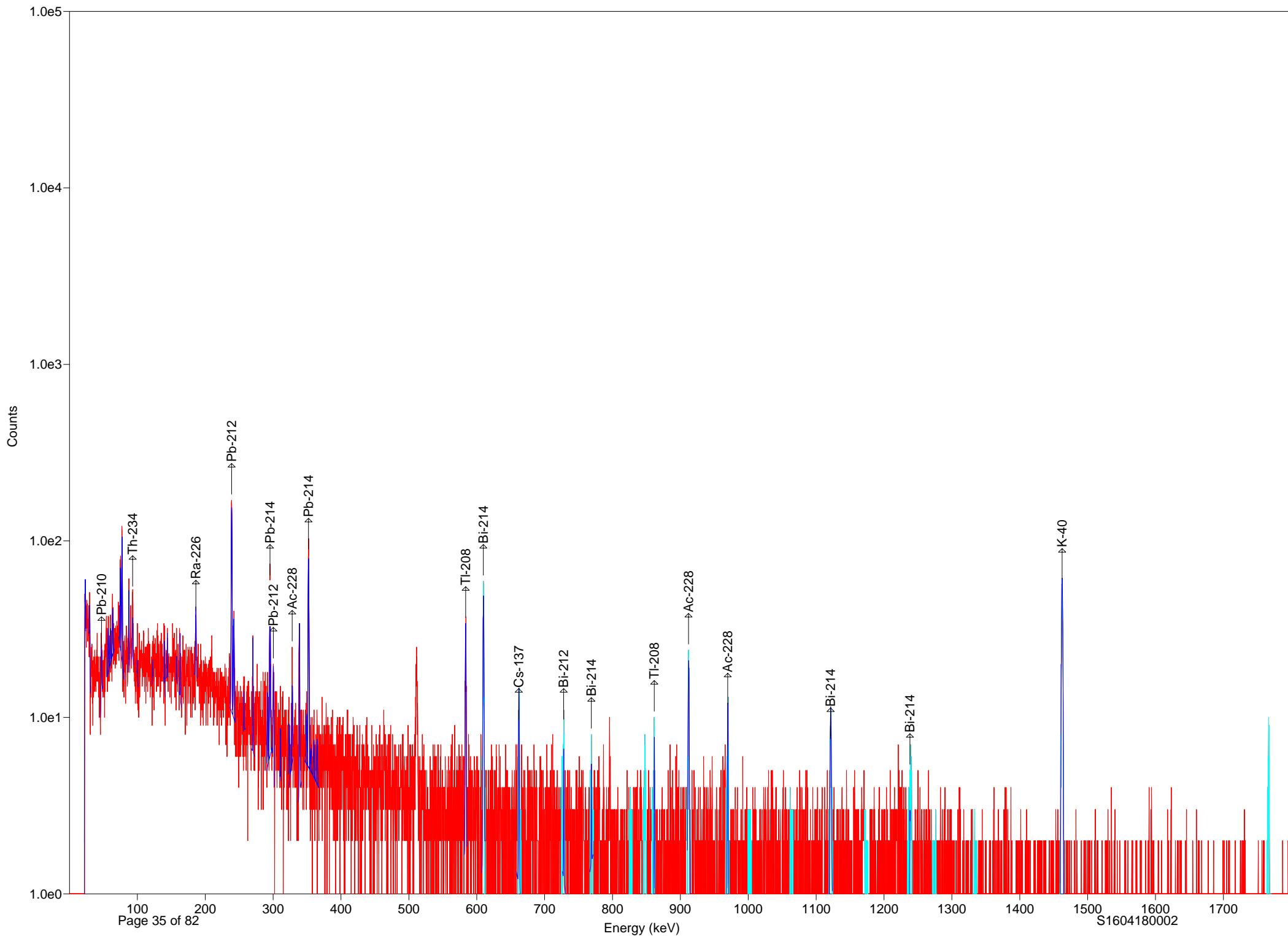
S1604180-008A.Rpt

Detector #1	ACQ	18-Apr-2016 at 11:45:40	RT = 4505.0	LT = 4500.0					
Rad	Chem	1							
S1604180-008A									
ROI#	RANGE(keV)	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY	(keV)
μCi	+/-								
1	607.80 612.63 0.0002 0.0000	474	390	25	609.69	1.72	2.28	Bi-214	609.31
2	660.21 665.47 0.0000 0.0000	184	96	19	662.25	1.57	1.77	Cs-137	661.66
3	724.23 729.94 0.0002 0.0001	146	42	20	727.88	0.90	1.26	Bi-212	727.00
4	766.11 772.03 0.0002 0.0001	112	28	18	768.85	0.62	1.77	Bi-214	768.36
5	823.77 829.47 0.0197 0.0512	55	5	13	828.82	0.22	0.35	Co-60	826.28
6	844.60 850.30 0.0000 0.0000	81	36	13	846.38	0.27	0.98	Co-56	846.77
7	857.32 863.02 0.0001 0.0000	100	41	15	861.76	0.31	0.54	Tl-208	860.56
8	908.62 914.32 0.0003 0.0000	263	231	18	911.55	1.70	2.52	Ac-228	911.20
9	965.83 971.97 0.0002 0.0000	193	106	20	969.49	1.43	1.86	Ac-228	968.97
10	998.71 1004.85 0.0004 0.0006	61	8	14	999.47	0.41	0.56	Pa-234M	1001.03
11	1060.09 1066.23 match!	60	-3	15	1062.72	1.21	1.40	No close library	
12	1118.17 1124.31 0.0003 0.0000	148	95	17	1121.00	1.41	2.56	Bi-214	1120.29
13	1170.34 1176.48 0.0000 0.0000	48	-15	15	1171.43	0.66	0.79	Co-60	1173.24
14	1233.24 1241.13 0.0000 0.0000	120	15	23	1238.83	0.38	0.55	Co-56	1238.28
15	1270.72 1277.29 match!	43	7	12	1271.81	0.22	0.35	No close library	
16	1329.88 1336.46 0.0000 0.0000	38	-9	13	1332.73	0.22	0.35	Co-60	1332.50
17	1457.64 1464.65 0.0042 0.0002	847	803	31	1461.38	1.61	2.88	K-40	1461.00
18	1762.38 1769.83 0.0002 0.0001	72	49	12	1765.70	0.59	0.87	Bi-214	1764.49



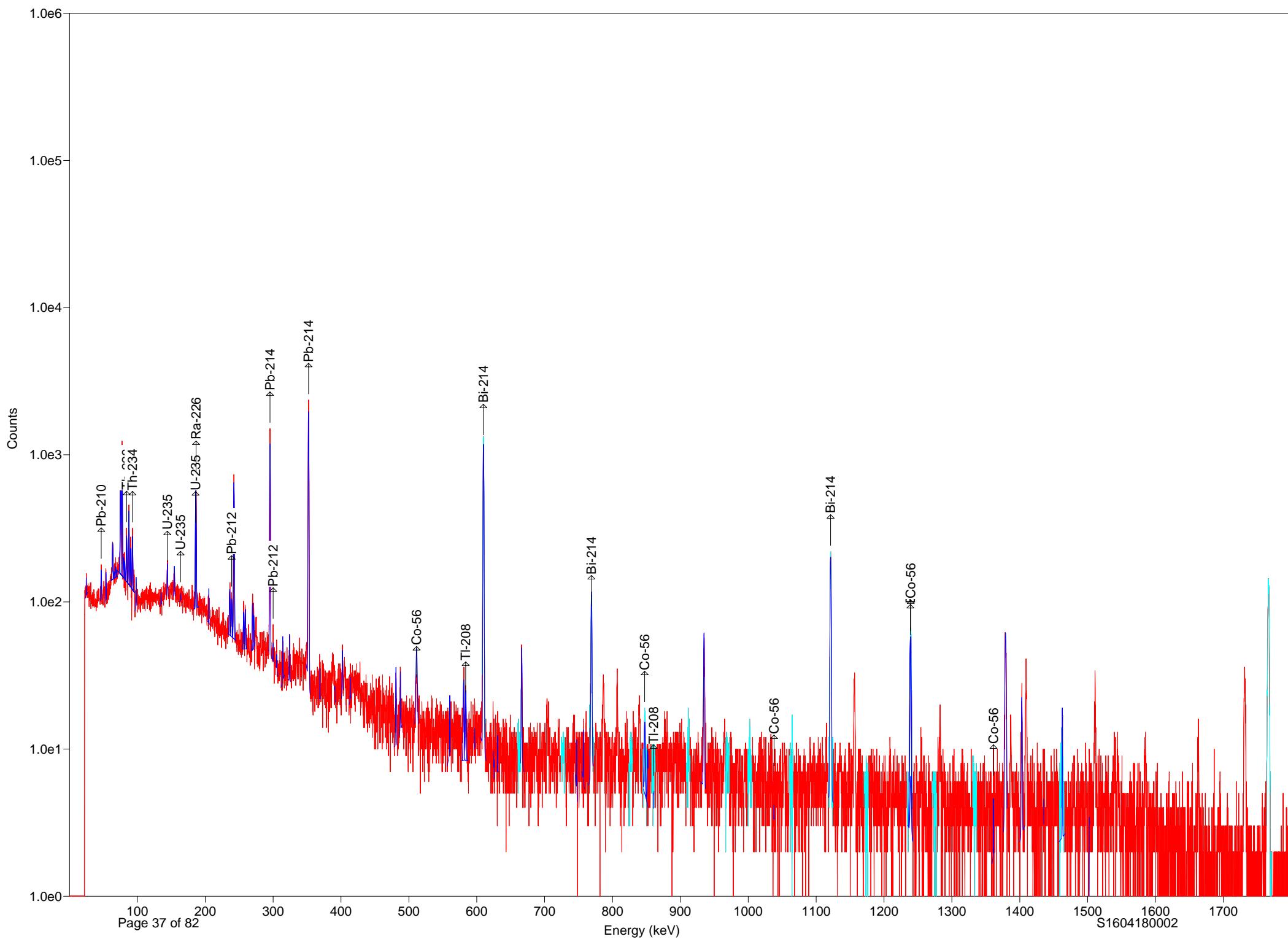
S1604180-009A.Rpt

Detector #1	ACQ	15-Apr-2016 at 7:17:40	RT = 4510.3	LT = 4500.0					
Rad	Chem	1							
S1604180-009A									
ROI#	RANGE(keV)	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY	(keV)
μCi	+/-								
1	607.80 612.63 0.0018 0.0000	4161	3812	69	609.69	1.26	1.96	Bi-214	609.31
2	660.21 665.47 0.0000 0.0000	205	-66	28	661.74	3.07	3.20	Cs-137	661.66
3	724.23 729.94 0.0006 0.0001	258	150	22	727.63	1.91	2.79	Bi-212	727.00
4	766.11 772.03 0.0018 0.0002	575	309	35	768.83	1.42	1.83	Bi-214	768.36
5	823.77 829.47 0.1300 0.0866	173	33	22	825.99	2.45	2.92	Co-60	826.28
6	844.60 850.30 0.0000 0.0000	186	64	22	847.05	0.43	1.63	Co-56	846.77
7	857.32 863.02 0.0002 0.0001	215	84	23	861.10	0.86	1.19	Tl-208	860.56
8	908.62 914.32 0.0003 0.0000	397	230	28	911.70	1.23	2.20	Ac-228	911.20
9	965.83 971.97 0.0002 0.0001	309	91	30	969.67	0.95	1.79	Ac-228	968.97
10	998.71 1004.85 0.0025 0.0011	201	56	24	1001.93	0.44	0.68	Pa-234M	1001.03
11	1060.09 1066.23 match!	127	11	21	1063.12	0.27	0.49	No close library	
12	1118.17 1124.31 0.0023 0.0001	970	806	37	1120.95	1.65	2.48	Bi-214	1120.29
13	1170.34 1176.48 0.0000 0.0000	117	-14	22	1173.63	0.77	0.96	Co-60	1173.24
14	1233.24 1241.13 0.0002 0.0000	420	266	32	1238.64	1.11	2.32	Co-56	1238.28
15	1270.72 1277.29 match!	109	31	18	1272.03	1.81	1.97	No close library	
16	1329.88 1336.46 0.0000 0.0000	71	-1	17	1330.98	0.22	0.35	Co-60	1332.50
17	1457.64 1464.65 0.0053 0.0002	1105	1006	38	1461.57	2.24	3.18	K-40	1461.00
18	1762.38 1769.83 0.0030 0.0001	727	663	31	1765.37	1.83	3.48	Bi-214	1764.49



S1604180-010A.Rpt

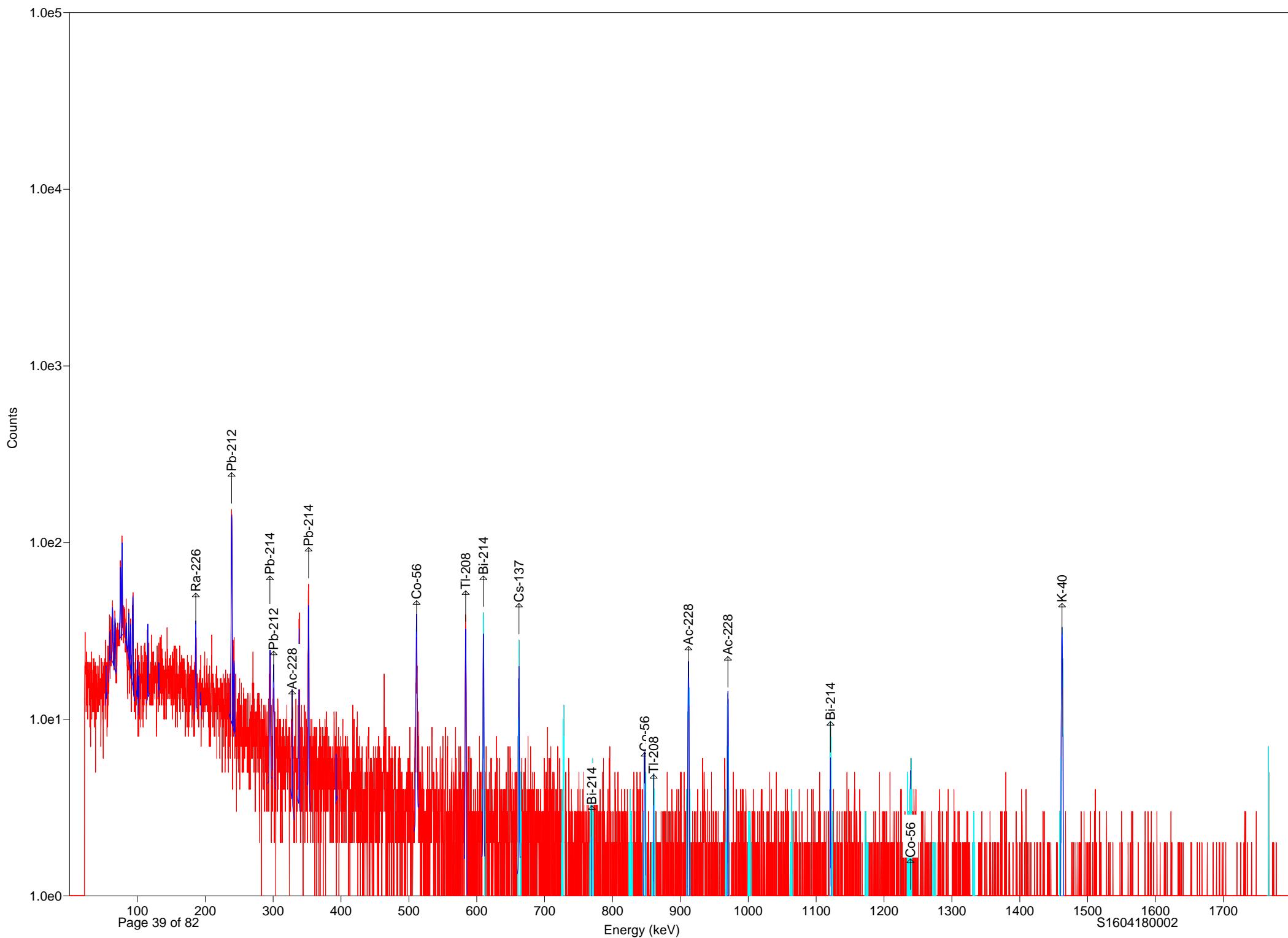
Detector #1	ACQ	15-Apr-2016	at	8:33:31	RT =	4505.6	LT =	4500.0			
ROI#	RANGE(keV)	Rad µCi	Chem 1	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY	(keV)
1	607.80 612.63	0.0001	0.0000	392	311	23	609.63	1.31	1.88	Bi-214	609.31
2	660.21 665.47	0.0000	0.0000	130	55	17	662.18	0.79	1.42	Cs-137	661.66
3	724.23 729.94	0.0002	0.0001	112	44	16	727.83	0.43	1.86	Bi-212	727.00
4	766.11 772.03	0.0002	0.0001	78	27	14	768.63	0.67	0.99	Bi-214	768.36
5	823.77 829.47	0.0000	0.0473	42	-8	12	824.65	1.75	1.89	Co-60	826.28
6	844.60 850.30	0.0000	0.0000	71	26	13	847.64	0.27	0.82	Co-56	846.77
7	857.32 863.02	0.0001	0.0000	80	26	14	861.02	0.60	1.17	Tl-208	860.56
8	908.62 914.32	0.0002	0.0000	189	135	18	911.75	1.57	1.88	Ac-228	911.20
9	965.83 971.97	0.0001	0.0000	114	41	17	969.82	0.45	1.22	Ac-228	968.97
10	998.71 1004.85	0.0000	0.0005	35	-4	12	1000.03	3.29	3.55	Pa-234M	1001.03
11	1060.09 1066.23	match!		46	7	12	1061.09	0.48	0.72	No close library	
12	1118.17 1124.31	0.0002	0.0000	112	78	14	1120.96	1.77	2.95	Bi-214	1120.29
13	1170.34 1176.48	0.0000	0.0000	37	-7	12	Could not properly fit the peak.				
14	1233.24 1241.13	0.0000	0.0000	86	55	14	1238.45	0.33	0.77	Co-56	1238.28
15	1270.72 1277.29	match!		26	-15	12	1275.32	0.33	0.53	No close library	
16	1329.88 1336.46	0.0000	0.0000	28	2	10	1332.95	0.33	0.53	Co-60	1332.50
17	1457.64 1464.65	0.0030	0.0001	585	563	25	1461.61	2.02	3.23	K-40	1461.00
18	1762.38 1769.83	0.0002	0.0000	66	54	10	1765.39	0.30	1.23	Bi-214	1764.49



UTS-4-CAN.Rpt

Detector #1 ACQ 18-Apr-2016 at 15:33:29 RT = 4513.2 LT = 4500.0
 Rad Chem 1
 UTS-4

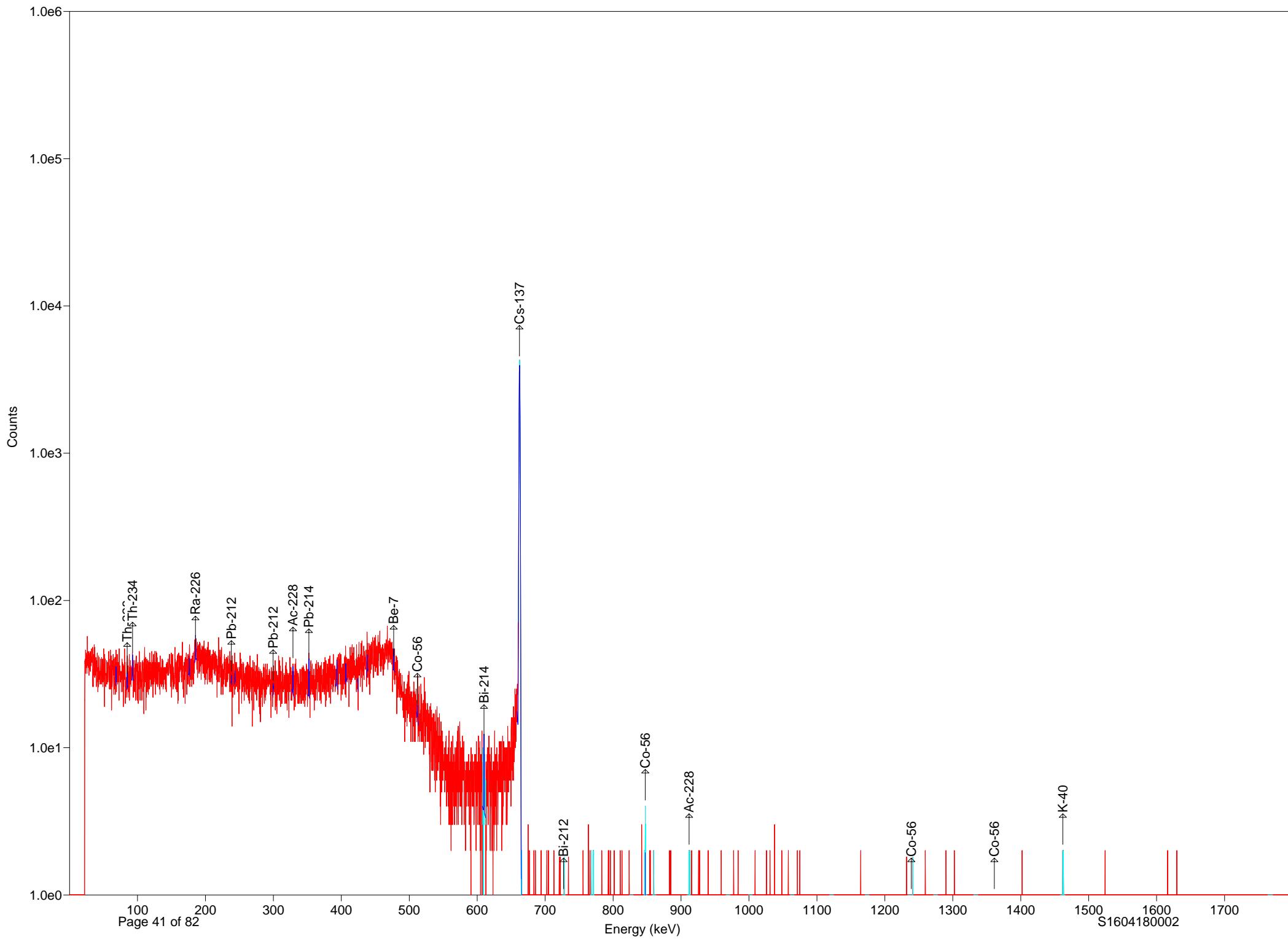
ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY	(keV)
1	607.80 612.63 0.0036 0.0000	8344	7612	98	609.68	1.24	1.93	Bi-214	609.31
2	660.21 665.47 0.0000 0.0000	322	-191	37	661.09	0.22	0.35	Cs-137	661.66
3	724.23 729.94 0.0001 0.0001	247	26	28	727.46	0.92	1.16	Bi-212	727.00
4	766.11 772.03 0.0037 0.0003	1004	649	44	768.82	1.45	2.20	Bi-214	768.36
5	823.77 829.47 0.1457 0.1024	222	37	26	826.52	1.11	1.93	Co-60	826.28
6	844.60 850.30 0.0000 0.0000	243	72	25	846.88	0.63	2.04	Co-56	846.77
7	857.32 863.02 0.0000 0.0001	202	4	26	859.29	0.24	0.39	Tl-208	860.56
8	908.62 914.32 0.0001 0.0000	258	55	27	911.25	0.26	0.42	Ac-228	911.20
9	965.83 971.97 0.0000 0.0001	241	-10	30	967.81	0.22	0.35	Ac-228	968.97
10	998.71 1004.85 0.0004 0.0012	223	10	28	1001.87	0.76	0.96	Pa-234M	1001.03
11	1060.09 1066.23 match!	177	-12	26	1064.25	0.22	0.35	No close library	
12	1118.17 1124.31 0.0044 0.0001	1780	1567	48	1120.83	1.65	2.39	Bi-214	1120.29
13	1170.34 1176.48 0.0000 0.0000	137	-23	24	1173.29	1.77	1.89	Co-60	1173.24
14	1233.24 1241.13 0.0004 0.0000	701	497	39	1238.75	1.83	2.71	Co-56	1238.28
15	1270.72 1277.29 match!	139	-1	24	1274.88	0.27	0.48	No close library	
16	1329.88 1336.46 0.0000 0.0000	144	-1	24	1334.96	0.32	1.09	Co-60	1332.50
17	1457.64 1464.65 0.0005 0.0001	224	92	26	1461.98	0.62	2.43	K-40	1461.00
18	1762.38 1769.83 0.0061 0.0002	1496	1356	45	1765.26	2.28	3.20	Bi-214	1764.49



ROCKYFLATS.Rpt

Detector #1 ACQ 18-Apr-2016 at 18:05:22 RT = 4504.9 LT = 4500.0
 Rad Chem 1
 ROCKYFLATS

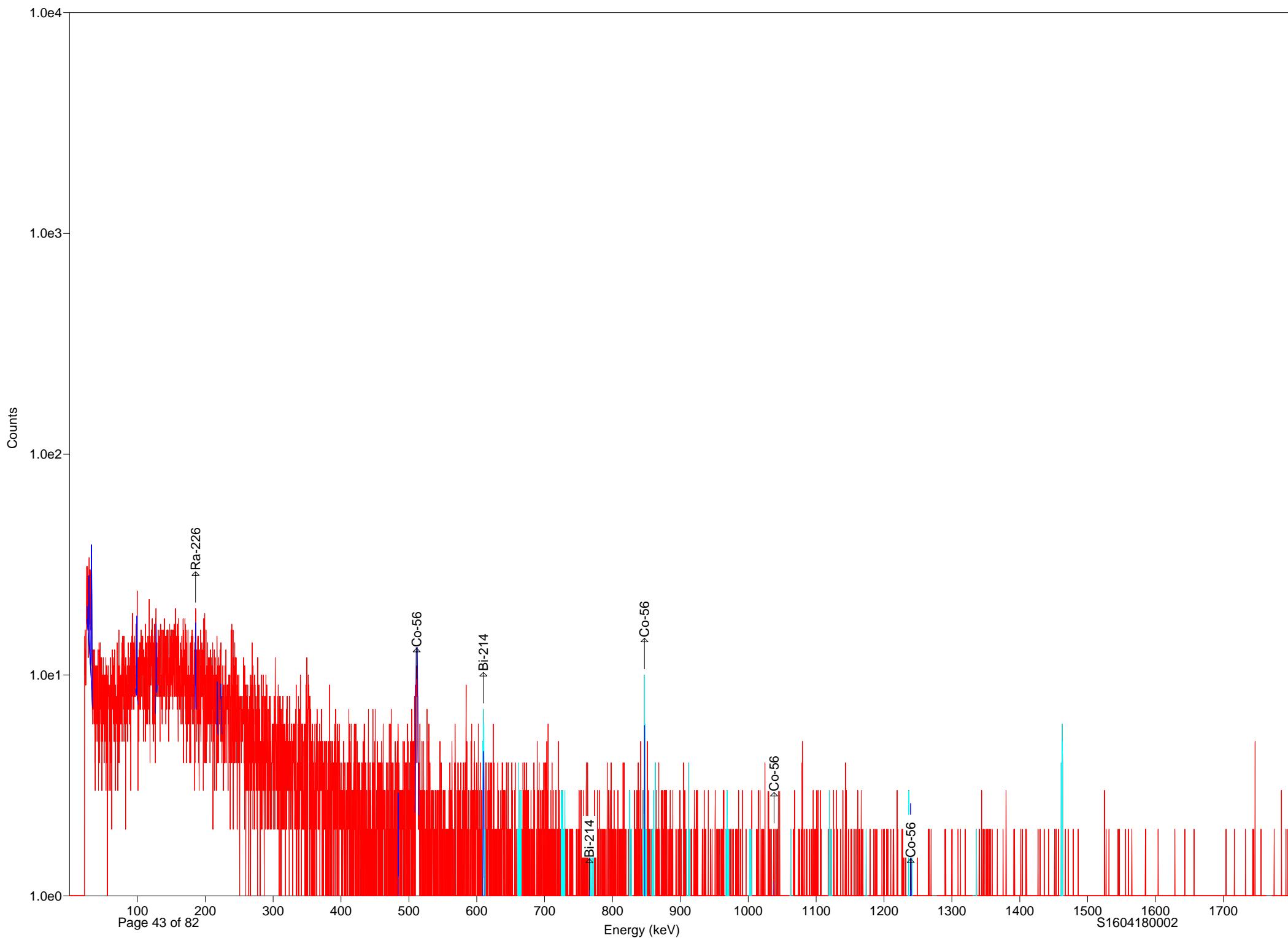
ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY	(keV)
1	607.80 612.63 0.0001 0.0000	259	178	20	609.70	0.97	1.43	Bi-214	609.31
2	660.21 665.47 0.0000 0.0000	179	96	18	662.06	0.63	1.36	Cs-137	661.66
3	724.23 729.94 0.0002 0.0000	84	61	11	727.85	0.71	1.85	Bi-212	727.00
4	766.11 772.03 0.0001 0.0001	59	17	13	768.69	2.11	2.42	Bi-214	768.36
5	823.77 829.47 0.0000 0.0433	41	0	11	825.97	1.97	2.10	Co-60	826.28
6	844.60 850.30 0.0000 0.0000	69	28	13	846.99	1.23	1.80	Co-56	846.77
7	857.32 863.02 0.0000 0.0000	51	15	11	859.73	0.24	0.39	Tl-208	860.56
8	908.62 914.32 0.0001 0.0000	175	116	17	911.74	1.55	2.20	Ac-228	911.20
9	965.83 971.97 0.0002 0.0000	129	81	16	969.83	0.92	2.48	Ac-228	968.97
10	998.71 1004.85 0.0009 0.0004	39	20	9	999.93	0.48	1.00	Pa-234M	1001.03
11	1060.09 1066.23 match!	25	6	8	1063.38	0.22	0.35	No close library	
12	1118.17 1124.31 0.0002 0.0000	71	56	10	1120.61	0.73	2.13	Bi-214	1120.29
13	1170.34 1176.48 0.0000 0.0000	25	6	8	1171.54	0.45	0.89	Co-60	1173.24
14	1233.24 1241.13 0.0000 0.0000	69	38	14	1238.94	0.73	0.94	Co-56	1238.28
15	1270.72 1277.29 match!	20	10	7	1272.69	2.96	3.16	No close library	
16	1329.88 1336.46 0.0000 0.0000	14	-7	8	1331.64	0.22	0.35	Co-60	1332.50
17	1457.64 1464.65 0.0015 0.0001	317	289	20	1461.43	1.69	3.15	K-40	1461.00
18	1762.38 1769.83 0.0001 0.0000	30	30	5	1765.23	0.38	0.99	Bi-214	1764.49



CS-137.Rpt

Detector #1 ACQ 15-Apr-2016 at 12:21:31 RT = 1205.4 LT = 1200.0
 Rad Chem 1
 CS-137 CALIBRATION

ROI#	RANGE(keV) μCi	GROSS +/-	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
1	607.80 612.63 0.0000 0.0000	146	27	19	609.88	0.39	0.55	Bi-214 609.31
2	660.21 665.47 0.0271 0.0002	28043	26310	178	662.10	1.31	2.02	Cs-137 661.66
3	724.23 729.94 0.0001 0.0000	8	8	2	727.74	0.22	0.35	Bi-212 727.00
4	766.11 772.03 0.0001 0.0001	12	3	6	767.43	3.73	3.86	Bi-214 768.36
5	823.77 829.47	4	4	2	Could not properly fit the peak.			
6	844.60 850.30 0.0000 0.0000	16	11	5	847.01	0.26	0.44	Co-56 846.77
7	857.32 863.02 0.0000 0.0000	7	-2	5	859.51	0.33	0.53	Tl-208 860.56
8	908.62 914.32 0.0000 0.0000	10	1	5	911.47	1.32	1.58	Ac-228 911.20
9	965.83 971.97	5	5	2	Could not properly fit the peak.			
10	998.71 1004.85	8	-2	5	Could not properly fit the peak.			
11	1060.09 1066.23	6	-4	5	Could not properly fit the peak.			
12	1118.17 1124.31	5	0	4	Could not properly fit the peak.			
13	1170.34 1176.48	5	0	4	Could not properly fit the peak.			
14	1233.24 1241.13	3	-9	7	Could not properly fit the peak.			
15	1270.72 1277.29	2	-3	4	Could not properly fit the peak.			
16	1329.88 1336.46 0.0002 0.0001	5	5	2	Could not properly fit the peak.			
17	1457.64 1464.65	12	12	3	1461.03	1.49	2.44	K-40 1461.00
18	1762.38 1769.83	1	1	1	Could not properly fit the peak.			



BACKGROUND.Rpt

Detector #1	ACQ	15-Apr-2016 at 12:42:19	RT = 4504.4	LT = 4500.0					
Rad	Chem	1							
BACKGROUND									
ROI#	RANGE(keV)	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY	(keV)
μCi	+/-								
1	607.80 612.63 0.0000 0.0000	59	40	9	609.50	1.16	2.17	Bi-214	609.31
2	660.21 665.47 0.0000 0.0000	31	10	8	661.74	0.22	0.35	Cs-137	661.66
3	724.23 729.94	32	-9	11	Could not properly fit the peak.				
4	766.11 772.03	24	-4	9	Could not properly fit the peak.				
5	823.77 829.47 0.0276 0.0276	21	7	7	824.87	0.33	0.61	Co-60	826.28
6	844.60 850.30 0.0000 0.0000	50	18	11	846.79	0.28	0.48	Co-56	846.77
7	857.32 863.02 0.0000 0.0000	26	-15	11	859.73	0.22	0.35	Tl-208	860.56
8	908.62 914.32 0.0000 0.0000	19	5	7	911.91	0.29	0.75	Ac-228	911.20
9	965.83 971.97 0.0000 0.0000	23	18	6	968.46	0.33	0.83	Ac-228	968.97
10	998.71 1004.85	22	-7	10	Could not properly fit the peak.				
11	1060.09 1066.23	15	-9	9	Could not properly fit the peak.				
12	1118.17 1124.31 0.0000 0.0000	16	6	6	1119.05	3.07	3.20	Bi-214	1120.29
13	1170.34 1176.48 0.0000 0.0000	11	1	6	1173.19	0.22	0.35	Co-60	1173.24
14	1233.24 1241.13 0.0000 0.0001	22	-3	11	1235.87	0.33	0.53	Bi-214	1238.11
15	1270.72 1277.29	7	2	4	Could not properly fit the peak.				
16	1329.88 1336.46 0.0000 0.0000	11	1	6	1335.58	0.22	0.35	Co-60	1332.50
17	1457.64 1464.65 0.0002 0.0000	41	30	8	1461.43	0.46	1.20	K-40	1461.00
18	1762.38 1769.83	7	1	5	Could not properly fit the peak.				

Table B-17 – Results of Dixon r tests applied to laboratory mean results

Material	Isotope	Set	No. sets	Test ratio	Critical	Value, r**
					P = 10%	P = 5%
UTS-1	^{210}Pb	Lab-7	7	.63	.51	.57
UTS-1	^{228}Ra	Lab-5*	4	.90	.77	.82
UTS-2	^{210}Pb	Lab-7	7	.63	.51	.57
UTS-4	^{230}Th	Lab-3	7	.71	.51	.57

*Test result overruled; set means of the other three sets were judged to be fortuitously close.

**Relevant probabilities are twice values for predesignated end of the set values (B2).

Table B-18 – Consensus values and related statistical parameters for isotope activities in tailings reference materials

Isotope	Consensus value, [CL], Bq g^{-1} ^a (No. sets, No. values, RSD (%), CV(%))			
	UTS-1	UTS-2	UTS-3	UTS-4
^{230}Th	3.6 [3.0 – 4.2] (7,28,21,10)	4.4 [3.3 – 5.5] (2,79,26,24)	11.3 [10.5 – 12.1] (7,29,9,5)	22.9 ^b [20.3 – 25.5] (6,24,13,7)
^{226}Ra	3.67 [3.52 – 3.82] (8,31,9,7)	5.6 [6.2 – 6.0] (8,37,13,8)	13.3 [12.7 – 13.9] (8,30,11,6)	38.6 [36.2 – 40.9] (6,33,9,5)
^{210}Pb	3.25 ^b [3.03 – 3.47] (6,23,9,7)	4.55 ^b [4.36 – 4.75] (6,39,12,9)	12.6 [12.1 – 13.2] (7,30,9,7)	32.4 [29.6 – 35.3] (7,26,9,4)
^{210}Po	3.1 [2.7 – 3.5] (6,27,10,4)	4.4 [3.7 – 5.1] (6,29,14,6)	11.8 [10.8 – 12.9] (6,29,8,4)	30.8 [25.8 – 35.9] (6,28,14,4)
$^{232}\text{Th}^{\text{c},\text{d}}$	.68 [.59 – .77] (5,18,16,11)	.88 [.67 – 1.08] (5,19,24,17)	(.16 ± .04)	(.48 ± .06)
^{228}Ra	.68 [.47 – .89] (4,14,19,10)	1.0 [0.7 – 1.4] (4,15,17,6)	–	–
$^{228}\text{Th}^{\text{d}}$	.71 [.58 – .84] (5,20,21,13)	.92 [.58 – 1.25] (5,21,29,11)	(.16 ± .04)	(.23 ± .04)
$^{231}\text{Pa}^{\text{d}}$	(.21 ± .03)	(.37 ± .05)	(.70 ± 1.0)	(2.4 ± .3)

a. CL = statistical uncertainty range at 95% confidence level, RSD = relative standard deviation of individual results (%), CV = average within-laboratory rel. std. dev. (%).

b. Data are exclusive of an outlying set.

c. ^{232}Th results from alpha spectrometry only. ^{232}Th concs. by NAA are incorporated with chemical results.

d. Single laboratory results and uncertainty estimates in brackets are for information only.



National Institute of Standards & Technology Certificate

Standard Reference Material® 4353A

Rocky Flats Soil Number 2

This Standard Reference Material (SRM) has been developed in cooperation with member laboratories of the International Committee for Radionuclide Metrology and other experienced metrology laboratories. The SRM consists of approximately 90 grams of air-dried, pulverized soil in a polyethylene bottle. The SRM is intended: for use in tests of measurements of radioactivity contained in matrices similar to the sample, for evaluating analytical methods, and as a generally available calibrated "real" sample matrix for laboratory intercomparison.

Radiological Hazards: This SRM contains low levels of anthropogenic and natural radioactivity and poses no radiological hazard. The SRM should be used only by qualified persons.

Chemical Hazards: The SRM is a dried sterilized soil and poses no chemical or biological hazard. However, inhalation or ingestion of the material should be avoided.

Storage and Handling: The SRM should be stored in a dry location at room temperature. The bottle should be shaken before opening in a chemical hood and should be recapped tightly as soon as subsamples are removed. The bottle (or any subsequent container) should always be clearly marked. If the SRM is transported, it should be packed, marked, labeled, and shipped in accordance with applicable national, international, and carrier regulations.

Preparation: This Standard Reference Material was prepared under the leadership of the Physics Laboratory, Ionizing Radiation Division, Radioactivity Group, Michael Unterweger, Acting Group Leader. The overall technical direction leading to the certification of this SRM was provided by Svetlana Nour and Kenneth G.W. Inn of the Radioactivity Group.

Statistical support was provided by James J. Filliben of the Information Technology Laboratory, Statistical Engineering Division.

The support aspects involved in the preparation, certification, and issuance of this SRM were coordinated through the NIST Measurement Services Division.

Technical Contacts: Svetlana Nour (e-mail: svetlana.nour@nist.gov; phone: 1-301-975-4927) and Kenneth G.W. Inn (e-mail: kenneth.inn@nist.gov; phone: 1-301-975-5541), NIST, Building 245, Room C114, Gaithersburg, MD 20899-8462, fax 1-301-926-7416.

Lisa Karam, Deputy Chief
Ionizing Radiation Division

Robert L. Watters, Jr., Chief
Measurement Services Division

Gaithersburg, Maryland 20899
July 2007

Details of the SRM preparation: This SRM is from the Rocky Flats Plant in north-central Colorado. The material was obtained from Rockwell International's Rocky Flats Plant (RFP) by the National Institute of Standards and Technology (NIST) of the U.S. Departments of Commerce and by the Environmental Measurements Laboratory (EML) of the U.S. Department of Homeland Security. The material was first coarsely sieved in the field to remove rocks larger than about 1.5 cm diameter. After air drying, the soil was blade milled twice. The soil was pulverized with a "pancake" style air jet mill to an average particle diameter of 8 μm . More than 99 percent, by weight, of the particles are less than 20 μm in diameter. The SRM was "V-cone" blended to optimize homogeneity and bottled in polyethylene bottles. The final bottled SRM was sterilized with > 50 kGy of ^{60}Co radiation to satisfy export regulations and to increase shelf-life time.

Instructions for Drying: When nonvolatile radionuclides are to be determined, working samples of this SRM should be dried at 40°C for 24 hours prior to weighing. Volatile radionuclides (e.g., ^{210}Po , ^{137}Cs , ^{210}Pb , ^{212}Pb and ^{214}Pb) should be determined on samples as received. Separate samples should be dried as previously described to obtain a correction factor for moisture. Correction for moisture content is to be made to the data for volatile radionuclides before comparing with the values given by this certificate. This procedure ensures that these radionuclides are not lost during drying (see Reference [1]*). The weight loss on drying is typically less than 4 percent.

Heterogeneity: Twenty-three bottles of the SRM were examined for gamma-ray heterogeneity by measuring their emission rates by counting them on a "5-in" (12.7 cm) NaI(Tl) detector coupled to a multichannel analyzer. The count rates from each measurement were analyzed for statistical difference for ten selected energy regions, and no detectable heterogeneity was observed.

This material has also been measured for alpha-particle emitting radionuclides using sample sizes of 1 gram to 100 grams. There are variations of results due to sample size. Based on over 100 plutonium and ^{241}Am measurements it was concluded that the material contains "hot" particles, and it is recommended that a sample size of 5 grams to 10 grams be used for radiochemical analysis and a sample size of 30 grams to 100 grams for gamma isotopic analysis. Statement of uncertainties, tolerance limits, and ranges of reported results incorporate the effects of heterogeneity.

Material Stability and Changes in Certified Values: This matrix is considered to be stable; however, its stability has not been rigorously assessed. NIST will monitor this material and will report any substantive changes in certification to the purchaser. Return of the enclosed registration card is mandatory to receive such notifications. The properties of the SRM are given in Table 1.

Calculation of Certified Massic Activity Values: The certified massic activity value for each nuclide (see Tables 2, 3 and 4) was determined from the evaluated average of the individual laboratory means. This approach was selected because of the well-behaved normal distribution of the laboratories' data.

Calculation of the Uncertainties for the Certified Values: The standard combined uncertainties (u_c) for each of the certified values were computed by incorporating components from three sources: 1) the estimated standard deviation of the mean of the laboratory mean values, 2) the $k = 1$ uncertainty associated with the radiochemical tracer SRMs, and 3) Type B scientific judgment. The uncertainty components were combined in quadrature as specified by the GUM. The expanded uncertainties (U) were computed using the Welch-Satterthwaite coverage factor. The expanded uncertainty (U) is taken as the 95 percent confidence interval.

Calculation of Certified Tolerance Limits: In addition to the certified massic activities and activity ratios, and their respective uncertainty values, Tables 2, 3, and 4 also provide 95/95 (normal) tolerance limits. Whereas the certified value is the mean of the population of measurements of the SRM and the expanded uncertainty for the certified value is at the 95 percent confidence limit, the tolerance limits are a measure of the spread of the population of measurements across the SRM. A 95/95 tolerance limit means that NIST is 95% confident that 95% of the population of SRM measurements fall within the specified limits. The tolerance limits are used when the number of replicates is small ($n < 5$), e.g., when the material is used as a periodic QC sample. For guidance on the use of tolerance limits in connection with this SRM, see Appendix 1.

Uncertified Massic Activities and Mass Ratios: The massic activities and mass ratios for the radionuclides given in Table 5 and 6 are not certified at this time, but may be certified at some future time if additional data become available. Users are invited to submit measurement data to contribute to the certification process. The data should be sent to one of the technical contacts listed on page 1.

Elemental Composition: Semi-quantitative elemental analysis of the Rocky Flats Number 2 matrix is listed in Table 8.

Table 1: Properties of SRM 4353A.

Certified Properties	
Radionuclides	See Table 2, 3 and 4
Reference time	1 April 1998
Certified massic activities	See Table 2, and 3
Certified activity ratios	See Table 4
Uncertainties (See Note 1)*	See Table 2, 3 and 4
Tolerance Limits	See Table 2, 3 and 4

Uncertified Properties

Source description	Rocky Flats Soil Number 2, approximately 90 g in a polyethylene bottle
Uncertified massic activities	See Table 5
Uncertified activity ratios	See Table 6
Range of reported values	See Tables 5 and 6
Half-lives used	See Table 7
Radiochemical and detection methods	See Table 7 and 9
Elemental composition	See Table 8
Participating laboratories and personnel	See Table 7 and 10

Table 2: Certified Massic Activities.[†]

Radionuclide	Massic Activity and uncertainty (mBq·g ⁻¹) (See Note 2)*	95/95 Tolerance Limit (mBq·g ⁻¹) (See Note 3)
²³⁸ Pu	0.278 ± 0.041	0.18 to 0.51
^{239,240} Pu	16.8 ± 1.8	6.0 to 26.8
²³⁸ U	39.6 ± 3.0	31.9 to 48.1
²³⁴ U	40.4 ± 3.0	33.7 to 47.7
²³⁵ U	1.88 ± 0.53	0.82 to 2.68
⁹⁰ Sr	10.5 ± 1.3	6.5 to 15.1

[†] Recommended sample size of at least 5 grams for radiochemical analysis. Refer to table 7 for uncertified information.

Table 3: Certified Massic Activities.[‡]

Radionuclide	Massic Activity and uncertainty (mBq·g ⁻¹) (See Note 2)	95/95 Tolerance Limit (mBq·g ⁻¹) (See Note 3)
¹³⁷ Cs	21.6 ± 2.6	13.7 to 30.0
²²⁸ Ra (See Note 4)	74.9 ± 7.5	61.4 to 91.6
²¹⁰ Pb	58.0 ± 9.9	41.8 to 79.7

[‡] Recommended sample size of at least 30 grams for gamma-ray measurement. Refer to table 7 for uncertified information.

Table 4: Certified Activity Ratios.[†]

Radionuclides Ratio	Ratio and uncertainty	95/95 Tolerance Limit (See Note 3)
²³⁴ U / ²³⁸ U	1.028 ± 0.036	0.92 to 1.14
²³⁸ Pu / (²³⁹ Pu+ ²⁴⁰ Pu)	0.017 ± 0.001	0.013 to 0.020
²²⁸ Th / ²³² Th	1.01 ± 0.10	0.84 to 1.14
²³⁰ Th / ²³² Th	0.671 ± 0.067	0.55 to 0.76

[†] Refer to table 7 for uncertified information.

Table 5: Uncertified Massic Activities.[†]

Radionuclide	Massic Activity (mBq·g⁻¹)	Lower and Upper Values of Reported Results (mBq·g⁻¹)
²²⁸ Th	72.4	61.6 to 88.4
²³⁰ Th	47.9	40.9 to 57.8
²³² Th	73.6	62.1 to 90.2
²³⁴ Th	60.1	28.9 to 103.3
²²⁶ Ra	42.4	28.4 to 52.7
²¹⁴ Pb	43.2	34.9 to 51.9
²¹⁴ Bi	40.6	28.4 to 53.2
²¹² Pb	90.2	83.3 to 95.7
²¹² Bi	79.5	68.8 to 87.3
²⁰⁸ Tl	51.3	26.8 to 67.7
⁴⁰ K	589	533 to 719
²⁴¹ Pu	17.0	13.0 to 30.0
²⁴¹ Am (alpha spectrometry)	2.5	0.6 to 5.4
²⁴¹ Am (gamma spectrometry)	4.7	3.7 to 6.6

[†] Radionuclides for which insufficient numbers of data sets or for which unresolved discrepant data sets were obtained. No uncertainties are provided because no meaningful estimates could be made. Refer to table 7 for uncertified information.

Table 6: Uncertified Mass Ratios.[‡]

Radionuclides	Mass Ratio	Lower and Upper Values of Reported Results
²⁴⁰ Pu / ²³⁹ Pu	$5.6 \cdot 10^{-2}$	$(5.3 \text{ to } 6.0) \cdot 10^{-2}$
²⁴¹ Pu / ²³⁹ Pu	$5.8 \cdot 10^{-4}$	$(0.4 \text{ to } 1.3) \cdot 10^{-3}$
²⁴¹ Pu / ²⁴⁰ Pu	$1.0 \cdot 10^{-2}$	$(0.8 \text{ to } 2.3) \cdot 10^{-2}$

[‡] Ratios for which insufficient numbers of data sets or for which unresolved discrepant data sets were obtained. No uncertainties are provided because no meaningful estimate could be made. Refer to table 7 for uncertified information.

Table 7: Uncertified Information for Tables 2 through 6.

Radionuclides	Number of Laboratories (and total assays)	Half Life (See Note 5)*	Methods (Table 9)	Contributing Laboratories Acronym (Table 10)
^{238}Pu	14 (169)	(87.7 ± 0.1) a	2b, 3b	BIL-GSL, CEMRC, EML, FSU, GSF, IAEA, LANL, NIST, OSU, RESL, SRNL, WHOI
$^{239,240}\text{Pu}$	14 (172)	(24110 ± 30) a (6561 ± 7) a	2b, 3b	BIL-GSL, CEMRC, EML, FSU, GSF, IAEA, LANL, NIST, OSU, RESL, SRNL, WHOI
^{238}U	7 (72)	$(4.468 \pm 0.003) 10^9$ a	2b, 3b, 3 e	CEMRC, EML, FSU, NIST, RESL, SRNL,
^{234}U	7 (72)	$(2.455 \pm 0.006) 10^5$ a	2b, 3b	CEMRC, EML, FSU, NIST, RESL, SRNL,
^{235}U	4 (38)	$(7.04 \pm 0.01) 10^8$ a	2b, 3b	CEMRC, EML, NIST, SRNL,
^{90}Sr	5 (38)	(28.79 ± 0.06) a	2c, 3c	EML, IAEA, RESL, WHOI
^{137}Cs	9 (82)	(30.07 ± 0.03) a	1a	BIL-GSL, EML, FSU, LANL, NIST, OSU, RESL, SRNL, WHOI
^{228}Ra (Note 4)	5 (42)	(5.75 ± 0.03) a	1a	BIL-GSL, FSU, NIST, RESL, SRNL
^{210}Pb	3 (24)	(22.20 ± 0.22) a	1a	FSU, NIST, SRNL
$^{234}\text{U} / ^{238}\text{U}$	8 (87)	$(2.455 \pm 0.006) 10^5$ a $(4.468 \pm 0.003) 10^9$ a	2b, 2e	BIL-GSL, CEMRC, EML, FSU, NIST, RESL, SRNL
$^{238}\text{Pu} / (^{239}\text{Pu} + ^{240}\text{Pu})$	14 (169)	(87.7 ± 0.1) a (24110 ± 30) a (6561 ± 7) a	2b	BIL-GSL, CEMRC, EML, FSU, GSF, IAEA, LANL, NIST, OSU, RESL, SRNL, WHOI,
$^{228}\text{Th} / ^{232}\text{Th}$	3 (27)	(1.9116 ± 0.0016) a $(1.40 \pm 0.01) 10^{10}$ a	2b	CEMRC, NIST, RESL
$^{230}\text{Th} / ^{232}\text{Th}$	3 (27)	$(7.538 \pm 0.030) 10^4$ a $(1.40 \pm 0.01) 10^{10}$ a	2b	CEMRC, NIST, RESL
^{228}Th	3 (27)	(1.9116 ± 0.0016) a	2b, 3b	CEMRC, NIST, RESL
^{230}Th	3 (27)	$(7.538 \pm 0.030) 10^4$ a	2b, 3b	CEMRC, NIST, RESL
^{232}Th	4 (42)	$(1.40 \pm 0.01) 10^{10}$ a	2b, 3b, 3 e	CEMRC, IAEA, NIST, RESL
^{234}Th	2 (21)	(24.10 ± 0.03) d	1a	FSU, SRNL
^{226}Ra	4 (38)	(1600 ± 7) a	1a	BIL-GSL, FSU, RESL, SRNL
^{214}Pb	3 (21)	(26.8 ± 0.9) min	1a	BIL-GSL, FSU, SRNL
^{214}Bi	3 (32)	(19.9 ± 0.4) min	1a	BIL-GSL, FSU, SRNL
^{212}Pb	1 (15)	(10.64 ± 0.01) h	1a	SRNL
^{212}Bi	1 (15)	(60.55 ± 0.06) min	1a	SRNL
^{208}Tl	3 (33)	(3.053 ± 0.004) min	1a	BIL-GSL, FSU, SRNL
^{40}K	2 (30)	$(1.248 \pm 0.003) 10^9$ a	1a	BIL-GSL, SRNL
^{241}Pu	2 (20)	(14.290 ± 0.006) a	2d	IAEA
$^{241}\text{Am} (\alpha \text{ spectrometry})$	13 (115)	(432.6 ± 0.6) a	2b, 3b	BIL-GSL, CEMRC, EML, FSU, IAEA, LANL, NIST, OSU, RESL, SRNL, WHOI

Table 7 (cont.): Uncertified Information for Tables 2 through 6.

Radionuclides	Number of Laboratories (and total assays)	Half Life (See Note 5)*	Methods (Table 9)	Contributing Laboratories Acronym (Table 10)
^{241}Am (γ spectrometry)	3 (24)	(432.6 ± 0.6) a	1a	FSU, NIST, SRNL
$^{240}\text{Pu} / ^{239}\text{Pu}$	1 (15)	(24110 ± 30) a (6561 ± 7) a	2e	SRNL
$^{241}\text{Pu} / ^{239}\text{Pu}$	1 (15)	(14.290 ± 0.006) a (6561 ± 7) a	2e	SRNL
$^{241}\text{Pu} / ^{240}\text{Pu}$	1 (15)	(14.290 ± 0.006) a (24110 ± 30) a	2e	SRNL

Table 8: Elemental Composition Based on Semi-quantitative X-Ray Fluorescence (XRF) analysis[†]. These values are not certified.

Element	Percent by mass (%)	Element	Percent by mass (%)
Si	36	Cl	0.004
Al	4.5	Cr	0.033
Fe	2.6	Cu	0.003
Mg	0.29	Ga	<0.001
Ca	0.40	Ni	0.018
Na	0.65	Pb	0.003
K	1.7	Rb	0.007
Ti	0.20	Sr	0.011
P	0.07	V	0.004
Mn	0.054	Y	0.002
C	1.5	Zn	0.007
S	0.02	Zr	0.02

[†]The estimated relative combined standard uncertainty for each reported concentration is from -33 % to +50 %. Data presented by John Sieber, Chemical Science and Technology Laboratory (CSTL).

Table 9: Radiochemical and Detection Methods.

1	Non-destructive
2	Fusion/total decomposition
3	Acid leach (any combination of the following HNO_3 , HCl , HF , HClO_4)
a	Germanium gamma-ray spectrometer
b	Silicon surface-barrier alpha-particle spectrometer
c	Beta-particle counter
d	Liquid scintillation counter
e	Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS), Atomic Mass Spectroscopy (AMS)

Table 10: Participating Laboratories and Personnel.

Laboratory Acronym	Laboratory	Country	Technical Contact
BIL - GSL	British Nuclear Group Sellafield Ltd.	United Kingdom	Dr. M. Froggatt
CEMRC	Carlsbad Environmental Monitoring & Research Center	United States of America	Dr. B. Stewart
EML	Environmental Measurements Laboratory	United States of America	Dr. H. Volchok, M. Feiner
FSU	Florida State University	United States of America	Dr. W. Burnett
GSF	National Research Center for Environment and Health, Institute of Radiation Protection	Germany	Dr. K. Bunzl
IAEA †	International Atomic Energy Agency	Austria	Dr. J. Moreno, Dr. K. Burns, Dr. G. Kis-Benedek
LANL	Los Alamos National Laboratory	United States of America	Dr. D. Decker, Dr. N. Koski, Dr. S.R. Garcia
NIST	National Institute of Standards and Technology	United States of America	S. Nour, Dr. K. Inn
OSU	Oregon State University	United States of America	Dr. T. Beasley
RESL †	Radiological and Environmental Sciences Laboratory (RESL)	United States of America	Dr. D. Olson , Dr. S. Bohrer
SRNL	Savannah River National Laboratory	United States of America	J. Cadieux
WHOI	Woods Hole Oceanographic Institution	United States of America	Dr. V. Bowen, Dr. H. Livingston

† Note: These laboratories participated twice, reporting two sets of data.

Appendix 1

Recommendations on the use of the certified values for validation of measurements or methods

Case 1. Single Observation

Recommendation.

If a single observation is made, check to see if that value is within the certified 95/95 (95% confidence / 95% coverage) tolerance interval as provided in column 3 of Tables 2, 3, and 4 . If yes, then conclude that the measurement/method process is acceptable; if no, then conclude that the process is questionable and adjust accordingly.

Example.

A laboratory analyzed ^{235}U with a single measurement of this SRM to validate its method. The measured result was 1.86 mBq/g. The NIST certified value (see column 2 of Table 2) is 1.88 mBq/g. Is the laboratory method valid?

Procedure.

Check to determine if the measured value 1.86 is within the tolerance interval as provided in column 3 of Table 2. The tolerance interval for ^{235}U is (0.82, 2.68). Since 1.86 falls within this interval, then conclude that no evidence exists that this process is invalid (that is, in practice, we conclude that the process is valid).

Case 2. Multiple Observations

Recommendation.

If multiple observations are made, then:

1. check that at least 95% of the data points are within the provided tolerance interval (if yes, then accept the process; otherwise, reject the process);
2. check (via the appropriate t-test) that the mean of the collected data points is "close enough" to the provided certified value.

Example.

A laboratory analyzed ^{235}U in 5 replicates of this SRM to validate its method. The analytical results were 1.86, 1.99, 1.85, 1.87, and 1.86 mBq/g. The NIST certified value is 1.88 mBq/g. Is the laboratory method valid?

Procedure.

1. Check to determine the proportion of the 5 measured values that are within the 95/95 tolerance interval (0.82, 2.68) as provided in column 3 of Table 2 (at least 95% of the 5 values should fall within). Since 5 out of 5 of the values fall within the interval, then we conclude that the process is valid.
- 2: Compare the mean of the 5 collected points (1.866) with the certified value (1.88) by performing the t-test .

2.1. NIST's Certified Value:

$$m = 1.88 \text{ mBq/g (see Table 2)}$$

2.2. Compute Laboratory Data Summary Statistics:

Sample size	$n = 5$
Sample mean	$x = 1.866 \text{ mBq/g}$
Sample standard deviation	$s = 0.015 \text{ mBq/g}$
Significant level of the t-test	$\alpha = 0.05$

2.3. Compute t-test Statistic Value:

$$\begin{aligned} \text{t-test statistic value} &= (x - m)/(s/(n)^{1/2}) \\ &= (1.866 - 1.88)/(0.015/(5)^{1/2}) \\ &= -2.064 \end{aligned}$$

2.4. Determine Cutoff Values for 95 % Confidence:

Upper 2.5% point of $t_{(n-1)}$ distribution = 2.776 (See Table A1)
 Lower 2.5% point of $t_{(n-1)}$ distribution = -2.776 (See Table A1)

3. Conclusions:

- 3.1 If test statistic value < lower cutoff value, then conclude method is invalid with negative bias relative to the certified value.
- 3.2 If test statistic value > upper cutoff value, then conclude method is invalid with positive bias relative to the certified value.
- 3.3 If neither of the above, then conclude method is valid.

Example's Conclusion:

Since the laboratory's test statistic value of -2.064 is neither > the upper cutoff value of 2.776 nor < the lower cutoff value of -2.776, case 3 applies and it can be concluded that the laboratory's method for ^{235}U analysis is valid.

Table A1: Probability points of the t distribution with (n-1) degrees of freedom.

Degrees of freedom (n-1)	Tail area probability, $t_{(n-1)}$ (cutoff values)	
	Upper 2.5 %	Lower 2.5 %
1	12.706	-12.706
2	4.303	-4.303
3	3.182	-3.182
4	2.776	-2.776
5	2.571	-2.571
6	2.447	-2.447
7	2.365	-2.365
8	2.306	-2.306
9	2.262	-2.262
10	2.228	-2.228

NOTES FOR TABLES 1, 2, 3 AND 7

- Note 1. For further information on the expression of uncertainties, see references [3] and [4].
- Note 2. The mean is the evaluated reference value from measurement results by the participating laboratories. The stated uncertainty is the 95% confidence interval based on a student-t distribution.
- Note 3. The tolerance limits are for 95 percent confidence and 95 percent coverage. Differences between laboratories have been eliminated so that the given limits reflect only between-measurement differences.
- Note 4. Radium-228 activity values are based on measurements of its ^{228}Ac daughter.
- Note 5. The stated uncertainty of the half-life is the standard uncertainty. See reference [5].

REFERENCES

- [1] R. Bock, *A Handbook of Decomposition Methods in Analytical Chemistry*, International Textbook Company, Limited. T. & A. Constable Ltd., Great Britain, 1979.
- [2] M. G. Natrella, Experimental Statistics, Handbook 91, 1963, United States Department of Commerce National Bureau of Standards
- [3] International Organization for Standardization (ISO), *Guide to the Expression of Uncertainty in Measurement*, 1993. Available from the American National Standards Institute, 11 West 42nd street, New York, NY 10036, USA. 1-212-642-4900. (Listed under ISO miscellaneous publications as "ISO Guide to the Expression 1993".)
- [4] B.N. Taylor and C.E.Kuyatt, *Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results*, NIST Technical Note 1297, 1994. Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402, USA.
- [5] Evaluated Nuclear Structure Data File (ENSDF), online database, National Nuclear Data Center, Brookhaven Laboratory (Upton, NY), November 2006. Refer to <http://www.nndc.bnl.gov/ensdf/>



CANADA CENTRE FOR MINERAL AND ENERGY TECHNOLOGY

REFERENCE URANIUM-THORIUM ORE DL-1a

CERTIFICATE OF ANALYSIS

	Recommended Value	95% Confidence Interval
U	0.0116%	± 0.0003%
Th	0.0076%	± 0.0004%
Ra-226	1.40 Bq/g	± 0.04 Bq/g
Pb-210	1.40 Bq/g	± 0.02 Bq/g

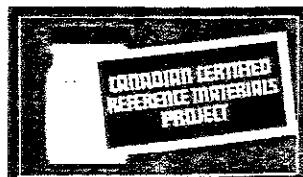
DESCRIPTION

DL-1a is intended as a replacement for DL-1 of which the stock is exhausted. It is waste rock typical of the property of Denison Mines Limited in Elliot Lake, Ontario, and is a pale yellow arkose sandstone containing uraninite and brannerite and possibly traces of monazite and uranothorite. The bulk material was dry-ground to minus 74 µm, blended, sampled systematically for analysis by optical fluorimetric and chemical methods to demonstrate homogeneity suitable for use as a reference material, and bottled in 200-g units. Evidence is available that DL-1a is in secular equilibrium.

CERTIFICATION

The consensus value for uranium is the unweighted mean of 286 accepted analytical determinations by 20 laboratories. Methods included titrimetry, colorimetry, fluorimetry, X-ray fluorescence, neutron activation analysis and radiochemistry.

The consensus value for thorium is the unweighted mean of 187 accepted analytical determinations by 14 laboratories. Methods included colorimetry, X-ray fluorescence, neutron activation analysis, radiometry and isotope dilution-mass spectrometry.



NON-CERTIFIED CONSTITUENTS

The concentration of the following constituents are given for information only.

	Value
Fe	0.93%
S	0.41%

INSTRUCTIONS FOR USE

The recommended values for DL-1a pertain to an "as is" basis.

LEGAL NOTICE

The Canadian Certified Reference Materials Project has prepared this reference material and statistically evaluated the analytical data for the interlaboratory certification program to the best of its ability. The Purchaser by receipt hereof releases and indemnifies the Canadian Certified Reference Materials Project from and against all liability and costs arising out of the use of this material and information.

REFERENCE

The preparation and certification procedures used for DL-1a are given in CANMET Reports 80-10 "DL-1a: A Certified Uranium-Thorium Reference Ore", 83-9E "Radium-226 in Certified Uranium References Ores DL-1a, BL-4a, DH-1a and BL-5" and 84-11E "Lead-210 in Certified Uranium Reference Ores DL-1a, BL-4a, DH-1a and BL-5" which are available free of charge on application to:

Coordinator, CCRMP

CANMET

555 Booth Street

Ottawa, Ontario K1A OG1

Canada

This Certificate of Analysis is available in French on request to the Coordinator, CCRMP.

Inter-Mountain Laboratories - RadChem Standards Notebook

Date: 1/28/16	Standard: Radium 226 11.06g Radium 226 standard 7.5 mL 2mL Nitric Acid (2014093036) was brought up to 100mL DI	pCi/mL L for 1/4mL 5.54 pCi/mL L	RADSTD-15-1
Expires: 1/28/17	Reference Date: 1/1/07		Initials: mB
Date: 2/16/16	Standard: Po-210 standard 0.3259g Po-210 (182341) and 2mL Nitric Acid (2014093036) was brought up to 100mL DI	pCi/mL L 2/16/17 24,778-22,804 pCi/mL L	RADSTD-15-2
Expires: 2/16/17	Reference Date: 8/1/15 11:00 MST		Initials: ms
Date: 3/10/16	Standard: DL-1a Canned DL-1a - 150.02 grams	pCi/mL L	RADSTD-15-3
Expires: Never	Reference Date:		Initials: T.P.
Date: 3/21/16	Standard: Thorium 229 0.9441g thorium 229 (SRM4328C) and 4mL nitric (2014093036) was brought up to 200mL DI	pCi/mL L	RADSTD-15-4
Expires: 3/31/17	Reference Date: 12/31/07 / EST 12:00		Initials: mB
Date: 3/31/16	Standard: Radium 228 standard 2.8902g Radium 228 (43395) and 4mL Nitric Acid (2014093036) brought up to 200mL DI	39.48 pCi/mL L	RADSTD-15-5
Expires: 3/31/16	Reference Date: 10/7/16 12:00 EST		Initials: mB
Date: 4/15/16	Standard: Radium -222 1mL RADSTO 1-1 and 9mL DI and scintilliator oil 10mL	pCi/mL L	RADSTD-15-6
Expires:	Reference Date: 9/9/1991 12:00 EST		Initials: ms
Date: 4/18/16	Standard: BL-4A Canned BL-4A +57.73 157.39 3 made	pCi/mL L	RADSTD-15-7
Expires: Never	Reference Date:		Initials: mB

ILE

om Page No. _____

Preparation of Radium 226

Standard from UTS-4

by Tom Potts

11-12-10

OHAUS Balance check with weights 54106

$$\begin{aligned}100\text{ g} &= 100.01\text{ g} \\50\text{ g} &= 50.00 \\5\text{ g} &= 5.00\end{aligned}$$

TARE 190.20 grams Sand \Rightarrow 211.35g

UTS-4 = 5.00 grams

Total weight = 195.20 grams

Canned & Sealed 11-12-10

UTS-4-CAN

Homogenized with a loss of 0.04 grams 1.8.

To Page No. _____

nessed & Understood by me,

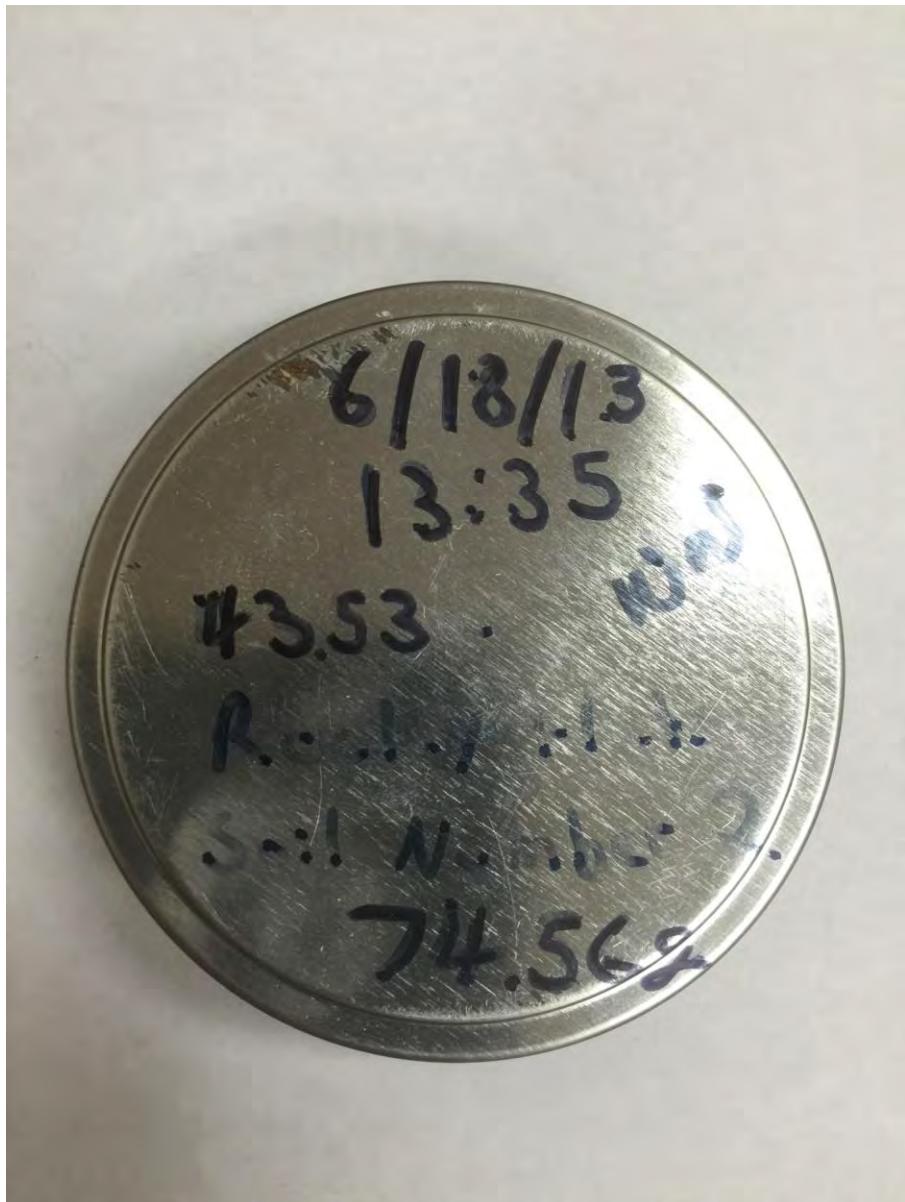
Date

Invented by

Date

S16041 0002

Recorded by



RAD STD-15-3.Rpt

Detector #1 ACQ 15-Apr-2016 at 9:49:43 RT = 4518.3 LT = 4500.0
 Rad Chem 1
 STD15-3

ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
1	607.80 612.63 0.0042 0.0001	9708	8849	106	609.70	1.30	1.94	Bi-214 609.31
2	660.21 665.47	437	-217	43	Could not properly fit the peak.			
3	724.23 729.94 0.0012 0.0001	635	320	37	727.77	1.47	2.11	Bi-212 727.00
4	766.11 772.03 0.0044 0.0003	1355	772	53	768.81	1.37	2.26	Bi-214 768.36
5	823.77 829.47 0.1654 0.1260	330	42	32	827.06	0.25	0.40	Co-60 826.28
6	844.60 850.30 0.0000 0.0000	322	29	32	847.74	0.86	1.17	Co-56 846.77
7	857.32 863.02 0.0004 0.0001	490	161	36	861.08	1.52	2.09	Tl-208 860.56
8	908.62 914.32 0.0012 0.0001	1332	1026	45	911.81	1.49	2.39	Ac-228 911.20
9	965.83 971.97 0.0010 0.0001	890	436	46	969.52	1.41	2.20	Ac-228 968.97
10	998.71 1004.85 0.0043 0.0015	387	97	34	1001.41	1.20	1.83	Pa-234M 1001.03
11	1060.09 1066.23 match!	214	-23	29	1061.41	0.22	0.35	No close library
12	1118.17 1124.31 0.0053 0.0002	2172	1858	55	1120.96	1.63	2.50	Bi-214 1120.29
13	1170.34 1176.48 0.0000 0.0000	236	-64	32	1174.50	0.22	0.35	Co-60 1173.24
14	1233.24 1241.13 0.0004 0.0000	960	627	48	1238.88	1.92	2.83	Co-56 1238.28
15	1270.72 1277.29 match!	190	40	25	1275.97	0.31	0.85	No close library
16	1329.88 1336.46 0.0000 0.0000	172	32	24	1335.58	0.26	0.42	Co-60 1332.50
17	1457.64 1464.65 0.0037 0.0002	864	693	38	1461.60	2.13	3.02	K-40 1461.00
18	1762.38 1769.83 0.0071 0.0002	1674	1557	46	1765.46	2.02	3.05	Bi-214 1764.49

RADSTD-15-3.Rpt

Detector #1 ACQ 18-Apr-2016 at 16:49:24 RT = 4517.6 LT = 4500.0
 Rad Chem 1
 STD15-3

ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY	(keV)
1	607.80 612.63 0.0043 0.0001	9879	9093	106	609.68	1.30	1.95	Bi-214	609.31
2	660.21 665.47 0.0000 0.0000	439	-186	42	661.30	0.22	0.35	Cs-137	661.66
3	724.23 729.94 0.0010 0.0002	673	259	41	727.72	0.99	1.85	Bi-212	727.00
4	766.11 772.03 0.0039 0.0003	1300	670	54	768.87	1.41	2.11	Bi-214	768.36
5	823.77 829.47 0.1890 0.1260	345	48	32	826.49	0.39	0.58	Co-60	826.28
6	844.60 850.30 0.0000 0.0000	332	30	32	847.45	0.22	0.35	Co-56	846.77
7	857.32 863.02 0.0004 0.0001	485	174	35	861.15	0.60	1.77	Tl-208	860.56
8	908.62 914.32 0.0012 0.0001	1338	987	47	911.75	1.66	2.37	Ac-228	911.20
9	965.83 971.97 0.0009 0.0001	856	402	46	969.61	1.56	2.10	Ac-228	968.97
10	998.71 1004.85 0.0060 0.0014	373	136	32	1001.71	1.00	2.11	Pa-234M	1001.03
11	1060.09 1066.23 match!	253	6	30	1065.57	0.22	0.35	No close library	
12	1118.17 1124.31 0.0052 0.0002	2096	1825	53	1120.92	1.65	2.49	Bi-214	1120.29
13	1170.34 1176.48 0.0000 0.0000	223	30	27	1171.18	4.70	4.91	Co-60	1173.24
14	1233.24 1241.13 0.0005 0.0000	969	667	47	1238.76	1.75	2.49	Co-56	1238.28
15	1270.72 1277.29 match!	184	39	25	1273.78	0.23	0.37	No close library	
16	1329.88 1336.46 0.0000 0.0000	164	9	25	1333.17	0.22	0.35	Co-60	1332.50
17	1457.64 1464.65 0.0035 0.0002	899	657	41	1461.51	1.94	3.01	K-40	1461.00
18	1762.38 1769.83 0.0064 0.0002	1647	1408	50	1765.25	2.25	3.12	Bi-214	1764.49

MB-358.Rpt

Detector #1	ACQ	24-Dec-2015 at 10:58:28	RT = 7206.8	LT = 7200.0
Rad	Chem	1		
MB-358				
ROI#	RANGE(keV)	GROSS	NET	+/-
	μ Ci	+/-		
1	607.80 612.63 0.0000 0.0000	127	35	17
2	660.21 665.47 0.0000 0.0000	52	-15	14
3	724.23 729.94 0.0000 0.0000	69	15	14
4	766.11 772.03 0.0001 0.0000	52	24	11
5	823.77 829.47 0.0000 0.0320	47	-3	13
6	844.60 850.30 0.0000 0.0000	114	51	16
7	857.32 863.02 0.0000 0.0000	49	-23	15
8	908.62 914.32 0.0000 0.0000	41	5	11
9	965.83 971.97 0.0000 0.0000	47	13	11
10	998.71 1004.85 0.0001 0.0003	37	3	11
11	1060.09 1066.23	29	-10	11
12	1118.17 1124.31 0.0000 0.0000	54	10	13
13	1170.34 1176.48 0.0000 0.0000	22	17	5
14	1233.24 1241.13 0.0001 0.0001	43	18	12
15	1270.72 1277.29 match!	13	8	5
16	1329.88 1336.46	24	-12	11
17	1457.64 1464.65 0.0002 0.0000	85	57	13
18	1762.38 1769.83 0.0001 0.0000	43	25	10

MB-11033.Rpt

Detector #1	ACQ	10-Nov-2015	at	9:24:46	RT =	7206.8	LT =	7200.0
ROI#	RANGE(keV)	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
	μCi	+/-						
1	607.80 612.63 0.0000 0.0000	146	54	17	610.12	0.47	0.75	Bi-214 609.31
2	660.21 665.47 0.0000 0.0000	51	-3	12	661.09	0.22	0.35	Cs-137 661.66
3	724.23 729.94 0.0000 0.0000	64	1	14	727.74	0.22	0.35	Bi-212 727.00
4	766.11 772.03 0.0000 0.0001	65	4	15	768.62	0.54	1.29	Bi-214 768.36
5	823.77 829.47 0.0000 0.0271	36	-5	11	825.21	0.41	0.56	Co-60 826.28
6	844.60 850.30 0.0000 0.0000	99	58	14	847.00	0.28	0.49	Co-56 846.77
7	857.32 863.02 0.0000 0.0000	44	21	10	859.61	1.61	1.81	Tl-208 860.56
8	908.62 914.32 0.0000 0.0000	43	-7	12	911.47	1.42	1.84	Ac-228 911.20
9	965.83 971.97 0.0000 0.0000	46	12	11	968.46	1.48	1.64	Ac-228 968.97
10	998.71 1004.85 0.0001 0.0003	39	5	11	1001.34	0.22	0.35	Pa-234M 1001.03
11	1060.09 1066.23 match!	38	-1	12	1062.28	0.22	0.35	No close library
12	1118.17 1124.31 0.0000 0.0000	58	19	12	1120.96	0.80	1.27	Bi-214 1120.29
13	1170.34 1176.48 0.0000 0.0000	30	-14	12	1172.31	0.22	0.35	Co-60 1173.24
14	1233.24 1241.13 0.0000 0.0000	52	9	15	1239.27	0.42	0.83	Co-56 1238.28
15	1270.72 1277.29 match!	35	4	11	1272.25	0.27	0.48	No close library
16	1329.88 1336.46	16	0	8	Could not properly fit the peak.			
17	1457.64 1464.65 0.0002 0.0000	77	66	10	1461.86	0.53	1.83	K-40 1461.00
18	1762.38 1769.83 0.0001 0.0000	52	46	8	1766.55	0.25	0.40	Bi-214 1764.49

MB-11050.Rpt

Detector #1 ACQ 17-Nov-2015 at 15:37:14 RT = 7207.1 LT = 7200.0
 Rad Chem 1
 MB-321

ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
1	607.80 612.63 0.0000 0.0000	115	73	13	610.02	0.38	1.52	Bi-214 609.31
2	660.21 665.47 0.0000 0.0000	53	7	12	661.63	0.47	1.05	Cs-137 661.66
3	724.23 729.94 0.0000 0.0000	50	-9	14	728.18	1.43	1.62	Bi-212 727.00
4	766.11 772.03 0.0000 0.0001	55	-1	14	769.84	0.22	0.35	Bi-214 768.36
5	823.77 829.47 0.0000 0.0295	44	-6	12	825.97	0.22	0.35	Co-60 826.28
6	844.60 850.30 0.0000 0.0000	85	49	13	847.82	0.60	1.60	Co-56 846.77
7	857.32 863.02 0.0000 0.0000	46	1	12	860.61	1.21	1.40	Tl-208 860.56
8	908.62 914.32 0.0000 0.0000	50	32	9	912.34	0.24	0.38	Ac-228 911.20
9	965.83 971.97 0.0000 0.0000	27	12	8	967.59	2.85	2.98	Ac-228 968.97
10	998.71 1004.85 0.0003 0.0003	50	11	12	1001.22	0.48	0.94	Pa-234M 1001.03
11	1060.09 1066.23 match!	27	12	8	1060.75	0.22	0.35	No close library
12	1118.17 1124.31 0.0000 0.0000	46	12	11	1121.78	0.41	0.56	Bi-214 1120.29
13	1170.34 1176.48	28	-30	13	Could not properly fit the peak.			
14	1233.24 1241.13 0.0000 0.0000	63	-17	19	1239.16	0.44	0.92	Co-56 1238.28
15	1270.72 1277.29	20	-1	9	Could not properly fit the peak.			
16	1329.88 1336.46	16	-10	9	Could not properly fit the peak.			
17	1457.64 1464.65 0.0002 0.0000	74	63	10	1461.66	0.64	2.38	K-40 1461.00
18	1762.38 1769.83 0.0001 0.0000	53	30	11	1765.13	1.33	1.68	Bi-214 1764.49

MB-11066.Rpt

Detector #1 ACQ 19-Nov-2015 at 15:10:18 RT = 7207.5 LT = 7200.0
 Rad Chem 1
 MB-323

ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
1	607.80 612.63 0.0000 0.0000	152	87	16	609.95	1.22	1.86	Bi-214 609.31
2	660.21 665.47 0.0000 0.0000	64	-11	15	661.74	0.33	0.75	Cs-137 661.66
3	724.23 729.94 0.0000 0.0000	45	13	11	725.99	0.88	1.01	Bi-212 727.00
4	766.11 772.03 0.0000 0.0001	61	0	14	768.96	0.29	1.62	Bi-214 768.36
5	823.77 829.47 0.0000 0.0295	45	0	12	824.98	4.03	4.46	Co-60 826.28
6	844.60 850.30 0.0000 0.0000	95	45	14	848.31	0.25	0.41	Co-56 846.77
7	857.32 863.02 0.0000 0.0000	32	9	9	859.91	0.32	0.52	Tl-208 860.56
8	908.62 914.32 0.0000 0.0000	49	22	10	911.69	1.70	1.86	Ac-228 911.20
9	965.83 971.97 0.0000 0.0000	45	-3	13	968.90	0.27	0.70	Ac-228 968.97
10	998.71 1004.85 0.0000 0.0003	36	-8	12	1001.13	0.33	0.53	Pa-234M 1001.03
11	1060.09 1066.23 match!	24	-5	10	1063.16	0.22	0.35	No close library
12	1118.17 1124.31 0.0000 0.0000	64	20	13	1120.59	0.37	1.21	Bi-214 1120.29
13	1170.34 1176.48 0.0000 0.0000	29	0	10	1171.43	0.33	0.53	Co-60 1173.24
14	1233.24 1241.13 0.0001 0.0001	42	11	13	1234.12	6.47	6.66	Bi-214 1238.11
15	1270.72 1277.29 match!	36	5	11	1274.44	0.33	0.53	No close library
16	1329.88 1336.46 0.0000 0.0000	23	18	6	1334.49	0.22	0.35	Co-60 1332.50
17	1457.64 1464.65 0.0002 0.0000	64	47	11	1461.66	1.14	2.59	K-40 1461.00
18	1762.38 1769.83 0.0001 0.0000	41	35	7	1765.42	0.29	0.95	Bi-214 1764.49

MB-11089.Rpt

Detector #1 Rad MB-331	ACQ Chem 1	27-Nov-2015 at 21:11:20	RT = 7206.8	LT = 7200.0				
ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
1	607.80 612.63 0.0000 0.0000	129	79	14	609.88	0.95	1.38	Bi-214 609.31
2	660.21 665.47	63	-12	15	Could not properly fit the peak.			
3	724.23 729.94 0.0000 0.0000	54	-9	14	728.40	0.33	0.53	Bi-212 727.00
4	766.11 772.03 0.0000 0.0001	66	10	14	769.62	0.26	0.44	Bi-214 768.36
5	823.77 829.47 0.0049 0.0295	43	2	12	825.75	0.22	0.35	Co-60 826.28
6	844.60 850.30 0.0000 0.0000	76	49	11	847.44	0.36	2.22	Co-56 846.77
7	857.32 863.02 0.0000 0.0000	48	3	12	859.29	0.22	0.35	Tl-208 860.56
8	908.62 914.32 0.0000 0.0000	56	24	11	912.32	0.27	1.14	Ac-228 911.20
9	965.83 971.97 0.0000 0.0000	44	15	11	969.34	0.25	0.39	Ac-228 968.97
10	998.71 1004.85 0.0004 0.0003	40	16	10	999.37	4.60	4.73	Pa-234M1001.03
11	1060.09 1066.23 match!	29	10	9	1064.47	0.22	0.35	No close library
12	1118.17 1124.31 0.0000 0.0000	58	24	12	1121.20	1.37	1.72	Bi-214 1120.29
13	1170.34 1176.48 0.0000 0.0000	18	-1	8	1174.50	0.33	0.53	Co-60 1173.24
14	1233.24 1241.13 0.0000 0.0000	39	8	12	1238.50	0.22	0.35	Co-56 1238.28
15	1270.72 1277.29 match!	28	2	10	1275.76	0.22	0.35	No close library
16	1329.88 1336.46 0.0000 0.0000	25	20	6	1330.54	5.37	5.57	Co-60 1332.50
17	1457.64 1464.65 0.0001 0.0000	47	30	10	1462.68	0.33	1.82	K-40 1461.00
18	1762.38 1769.83 0.0001 0.0000	43	20	11	1765.45	0.82	1.24	Bi-214 1764.49

MB-11117.Rpt

Detector #1	ACQ	02-Dec-2015 at 19:18:00	RT = 7207.4	LT = 7200.0
Rad	Chem	1		
MB-336				
ROI#	RANGE(keV)	GROSS	NET	+/-
	μ Ci +/-			
1	607.80 612.63 0.0000 0.0000	130	69	15
2	660.21 665.47 0.0000 0.0000	64	6	13
3	724.23 729.94 0.0000 0.0000	58	4	13
4	766.11 772.03 0.0001 0.0000	57	20	12
5	823.77 829.47 0.0000 0.0345	47	-16	14
6	844.60 850.30 0.0000 0.0000	97	61	13
7	857.32 863.02 0.0000 0.0000	46	10	11
8	908.62 914.32 0.0000 0.0000	53	-1	13
9	965.83 971.97 0.0000 0.0000	42	13	11
10	998.71 1004.85 0.0000 0.0003	36	-3	12
11	1060.09 1066.23 match!	27	-7	11
12	1118.17 1124.31 0.0001 0.0000	52	37	9
13	1170.34 1176.48 0.0000 0.0000	26	-13	11
14	1233.24 1241.13 0.0000 0.0000	50	31	11
15	1270.72 1277.29 match!	33	2	11
16	1329.88 1336.46	22	-25	13
17	1457.64 1464.65 0.0001 0.0000	72	33	14
18	1762.38 1769.83 0.0001 0.0000	43	37	8

MB-11169.Rpt

Detector #1 ACQ 15-Dec-2015 at 10:28:51 RT = 7208.2 LT = 7200.0
 Rad Chem 1
 MB-336

ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
1	607.80 612.63 0.0000 0.0000	132	74	15	609.75	0.73	2.20	Bi-214 609.31
2	660.21 665.47 0.0000 0.0000	62	-5	14	663.72	0.22	0.35	Cs-137 661.66
3	724.23 729.94 0.0000 0.0000	48	-11	13	727.96	0.22	0.35	Bi-212 727.00
4	766.11 772.03 0.0001 0.0001	74	18	14	767.87	0.66	0.79	Bi-214 768.36
5	823.77 829.47 0.0000 0.0320	44	-15	13	826.62	0.22	0.35	Co-60 826.28
6	844.60 850.30 0.0000 0.0000	99	54	14	847.64	1.32	2.02	Co-56 846.77
7	857.32 863.02 0.0000 0.0000	43	2	12	858.41	1.75	1.89	Tl-208 860.56
8	908.62 914.32 0.0000 0.0000	52	29	10	912.05	0.42	0.63	Ac-228 911.20
9	965.83 971.97 0.0000 0.0000	36	-3	12	968.68	0.27	0.99	Ac-228 968.97
10	998.71 1004.85 0.0007 0.0002	40	25	9	1003.72	0.35	1.39	Pa-234M 1001.03
11	1060.09 1066.23 match!	21	-3	9	1060.75	0.22	0.35	No close library
12	1118.17 1124.31 0.0000 0.0000	55	21	12	1120.75	0.47	2.15	Bi-214 1120.29
13	1170.34 1176.48 0.0000 0.0000	28	-6	11	1172.75	0.22	0.35	Co-60 1173.24
14	1233.24 1241.13 0.0000 0.0000	39	39	6	1239.32	0.55	1.96	Co-56 1238.28
15	1270.72 1277.29 match!	28	-13	12	1272.25	0.33	0.53	No close library
16	1329.88 1336.46	17	-4	9	Could not properly fit the peak.			
17	1457.64 1464.65 0.0001 0.0000	66	38	12	1462.04	0.48	1.20	K-40 1461.00
18	1762.38 1769.83 0.0001 0.0000	41	35	7	1766.28	0.33	0.85	Bi-214 1764.49

MB-11303.Rpt

Detector #1 ACQ 18-Jan-2016 at 16:35:25 RT = 7210.3 LT = 7200.0
 Rad Chem 1
 MB-018

ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
1	607.80 612.63 0.0000 0.0000	141	76	16	609.85	0.52	1.47	Bi-214 609.31
2	660.21 665.47 0.0000 0.0000	59	9	12	662.18	0.22	0.35	Cs-137 661.66
3	724.23 729.94 0.0000 0.0000	60	1	14	725.11	3.29	3.42	Bi-212 727.00
4	766.11 772.03 0.0000 0.0000	51	4	13	766.77	0.22	0.35	Bi-214 768.36
5	823.77 829.47 0.0049 0.0295	47	2	12	828.63	0.29	0.50	Co-60 826.28
6	844.60 850.30 0.0000 0.0000	102	43	15	847.53	0.52	1.77	Co-56 846.77
7	857.32 863.02 0.0000 0.0000	34	-7	11	861.04	0.26	0.44	Tl-208 860.56
8	908.62 914.32 0.0000 0.0000	70	20	13	912.23	0.92	1.64	Ac-228 911.20
9	965.83 971.97 0.0000 0.0000	41	2	12	969.56	0.22	0.35	Ac-228 968.97
10	998.71 1004.85 0.0010 0.0002	41	36	7	1000.80	0.39	0.55	Pa-234M 1001.03
11	1060.09 1066.23 match!	31	21	7	1063.12	0.35	1.83	No close library
12	1118.17 1124.31 0.0000 0.0000	53	24	11	1120.69	0.40	0.61	Bi-214 1120.29
13	1170.34 1176.48 0.0000 0.0000	34	15	9	1174.72	0.22	0.35	Co-60 1173.24
14	1233.24 1241.13 0.0000 0.0000	40	3	13	1238.54	0.32	1.31	Co-56 1238.28
15	1270.72 1277.29 match!	20	15	6	1276.06	0.87	1.00	No close library
16	1329.88 1336.46 0.0000 0.0000	19	14	5	1335.58	0.27	0.48	Co-60 1332.50
17	1457.64 1464.65 0.0001 0.0000	60	38	11	1461.14	0.25	0.40	K-40 1461.00
18	1762.38 1769.83 0.0001 0.0000	54	25	12	1765.35	1.63	1.84	Bi-214 1764.49

MB-11304.Rpt

Detector #1 ACQ 19-Jan-2016 at 16:25:39 RT = 7210.2 LT = 7200.0
 Rad Chem 1
 MB-019

ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
1	607.80 612.63 0.0000 0.0000	163	105	16	609.63	1.02	1.77	Bi-214 609.31
2	660.21 665.47 0.0000 0.0000	67	9	13	663.75	0.31	0.54	Cs-137 661.66
3	724.23 729.94 0.0000 0.0000	42	19	9	727.82	0.89	2.02	Bi-212 727.00
4	766.11 772.03 0.0001 0.0000	65	18	13	768.30	0.26	0.44	Bi-214 768.36
5	823.77 829.47 0.0000 0.0295	45	0	12	824.43	2.19	2.32	Co-60 826.28
6	844.60 850.30 0.0000 0.0000	101	42	15	847.01	0.95	1.59	Co-56 846.77
7	857.32 863.02 0.0000 0.0000	47	2	12	859.29	0.22	0.35	Tl-208 860.56
8	908.62 914.32 0.0000 0.0000	58	17	12	912.56	0.25	0.39	Ac-228 911.20
9	965.83 971.97 0.0000 0.0000	44	-14	14	966.49	0.22	0.35	Ac-228 968.97
10	998.71 1004.85 0.0002 0.0003	38	9	10	1003.54	0.26	0.44	Pa-234M 1001.03
11	1060.09 1066.23	30	-14	12	Could not properly fit the peak.			
12	1118.17 1124.31 0.0000 0.0000	54	15	12	1120.89	0.45	0.99	Bi-214 1120.29
13	1170.34 1176.48 0.0000 0.0000	30	-4	11	1171.00	0.88	1.01	Co-60 1173.24
14	1233.24 1241.13 0.0001 0.0001	45	26	11	1234.12	5.37	5.65	Bi-214 1238.11
15	1270.72 1277.29 match!	37	6	11	1273.24	0.43	0.65	No close library
16	1329.88 1336.46 0.0000 0.0000	27	-4	11	1330.98	4.82	4.95	Co-60 1332.50
17	1457.64 1464.65 0.0002 0.0000	71	54	11	1461.97	0.88	1.75	K-40 1461.00
18	1762.38 1769.83 0.0001 0.0000	38	38	6	1765.67	1.17	1.62	Bi-214 1764.49

MB-11319.Rpt

Detector #1 ACQ 22-Jan-2016 at 15:59:31 RT = 7209.2 LT = 7200.0
 Rad Chem 1
 MB-022

ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
1	607.80 612.63 0.0000 0.0000	162	85	17	609.81	1.20	1.97	Bi-214 609.31
2	660.21 665.47 0.0000 0.0000	48	6	11	664.37	0.26	0.44	Cs-137 661.66
3	724.23 729.94 0.0000 0.0000	52	20	11	726.74	1.82	3.34	Bi-212 727.00
4	766.11 772.03 0.0000 0.0001	60	-1	14	768.63	0.80	0.98	Bi-214 768.36
5	823.77 829.47 0.0345 0.0271	46	14	11	826.66	0.32	0.74	Co-60 826.28
6	844.60 850.30 0.0000 0.0000	85	49	13	847.59	0.46	0.75	Co-56 846.77
7	857.32 863.02 0.0000 0.0000	48	-11	13	860.17	0.22	0.35	Tl-208 860.56
8	908.62 914.32 0.0000 0.0000	50	5	12	911.47	0.25	0.39	Ac-228 911.20
9	965.83 971.97 0.0000 0.0000	41	-3	12	969.88	0.39	0.55	Ac-228 968.97
10	998.71 1004.85 0.0003 0.0003	40	11	11	1002.12	0.41	0.56	Pa-234M 1001.03
11	1060.09 1066.23 match!	21	11	6	1060.75	1.42	1.62	No close library
12	1118.17 1124.31 0.0001 0.0000	59	59	7	1121.33	0.79	1.78	Bi-214 1120.29
13	1170.34 1176.48 0.0000 0.0000	23	8	8	1171.00	0.26	0.96	Co-60 1173.24
14	1233.24 1241.13 0.0001 0.0000	36	17	10	1235.43	1.75	1.88	Bi-214 1238.11
15	1270.72 1277.29 match!	21	5	8	1271.37	2.63	2.76	No close library
16	1329.88 1336.46	23	-3	10	Could not properly fit the peak.			
17	1457.64 1464.65 0.0002 0.0000	70	64	9	1461.08	1.84	3.60	K-40 1461.00
18	1762.38 1769.83 0.0001 0.0000	42	24	10	1765.08	1.00	1.19	Bi-214 1764.49

MB-11381.Rpt

Detector #1 ACQ 09-Feb-2016 at 13:22:38 RT = 7210.0 LT = 7200.0
 Rad Chem 1
 MB-11372

ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
1	607.80 612.63 0.0000 0.0000	145	45	18	609.89	0.65	0.96	Bi-214 609.31
2	660.21 665.47 0.0000 0.0000	56	6	12	661.20	0.84	1.00	Cs-137 661.66
3	724.23 729.94 0.0001 0.0000	59	27	11	727.55	0.29	0.50	Bi-212 727.00
4	766.11 772.03 0.0001 0.0001	68	17	14	768.78	0.35	0.83	Bi-214 768.36
5	823.77 829.47 0.0000 0.0320	48	-11	13	824.87	0.22	0.35	Co-60 826.28
6	844.60 850.30 0.0000 0.0000	90	40	14	847.45	0.40	0.93	Co-56 846.77
7	857.32 863.02 0.0000 0.0000	36	9	10	858.19	0.27	0.48	Tl-208 860.56
8	908.62 914.32 0.0000 0.0000	56	24	11	911.58	0.91	2.34	Ac-228 911.20
9	965.83 971.97 0.0000 0.0000	36	17	9	970.54	0.42	1.49	Ac-228 968.97
10	998.71 1004.85 0.0003 0.0003	40	11	11	999.37	0.22	0.35	Pa-234M 1001.03
11	1060.09 1066.23 match!	29	-10	11	1061.19	0.33	0.53	No close library
12	1118.17 1124.31 0.0000 0.0000	48	0	13	1120.37	1.37	1.58	Bi-214 1120.29
13	1170.34 1176.48	19	0	8	Could not properly fit the peak.			
14	1233.24 1241.13 0.0000 0.0000	36	-7	14	1239.48	0.41	0.56	Co-56 1238.28
15	1270.72 1277.29	19	-7	10	Could not properly fit the peak.			
16	1329.88 1336.46 0.0000 0.0000	23	-8	11	1335.80	0.22	0.35	Co-60 1332.50
17	1457.64 1464.65 0.0001 0.0000	55	38	10	1461.97	0.44	1.23	K-40 1461.00
18	1762.38 1769.83 0.0001 0.0000	42	30	9	1766.33	0.24	0.39	Bi-214 1764.49

MB-11412.Rpt

Detector #1 Rad MB-11412	ACQ Chem 1	18-Feb-2016 at 8:43:01	RT = 7207.5	LT = 7200.0				
ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
1	607.80 612.63 0.0000 0.0000	136	67	16	609.35	0.38	1.48	Bi-214 609.31
2	660.21 665.47 0.0000 0.0000	55	17	11	663.16	0.39	0.55	Cs-137 661.66
3	724.23 729.94	56	-25	16	Could not properly fit the peak.			
4	766.11 772.03 0.0000 0.0001	63	-2	15	770.28	0.22	0.35	Bi-214 768.36
5	823.77 829.47 0.0123 0.0295	50	5	12	825.53	2.96	3.16	Co-60 826.28
6	844.60 850.30 0.0000 0.0000	104	63	14	847.31	0.51	1.32	Co-56 846.77
7	857.32 863.02 0.0000 0.0000	49	4	12	858.19	0.27	0.48	Tl-208 860.56
8	908.62 914.32 0.0000 0.0000	63	-5	15	910.15	1.75	1.89	Ac-228 911.20
9	965.83 971.97 0.0000 0.0000	40	16	10	968.90	0.26	0.66	Ac-228 968.97
10	998.71 1004.85 0.0000 0.0004	46	-7	14	1002.88	0.22	0.35	Pa-234M 1001.03
11	1060.09 1066.23 match!	27	8	9	1063.60	0.22	0.35	No close library
12	1118.17 1124.31 0.0000 0.0000	60	26	12	1120.63	0.31	0.99	Bi-214 1120.29
13	1170.34 1176.48 0.0000 0.0000	32	27	6	1172.97	0.24	0.39	Co-60 1173.24
14	1233.24 1241.13 0.0001 0.0001	48	11	14	1233.90	6.79	6.93	Bi-214 1238.11
15	1270.72 1277.29 match!	28	18	7	1274.00	2.47	2.67	No close library
16	1329.88 1336.46	26	-15	12	Could not properly fit the peak.			
17	1457.64 1464.65 0.0002 0.0000	82	60	12	1461.35	0.92	1.18	K-40 1461.00
18	1762.38 1769.83 0.0001 0.0000	44	26	10	1766.11	0.27	1.10	Bi-214 1764.49

MB-11466.Rpt

Detector #1	ACQ	01-Mar-2016 at 16:12:34	RT = 7208.6	LT = 7200.0				
Rad	Chem	1						
MB-061								
ROI#	RANGE(keV)	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
	μCi	$+$ / $-$						
1	607.80 612.63 0.0000 0.0000	117	44	15	609.57	0.40	1.41	Bi-214 609.31
2	660.21 665.47 0.0000 0.0000	64	22	12	664.37	0.25	0.39	Cs-137 661.66
3	724.23 729.94 0.0000 0.0000	56	-7	14	727.74	0.22	0.35	Bi-212 727.00
4	766.11 772.03 0.0000 0.0000	47	-4	13	769.18	2.30	2.50	Bi-214 768.36
5	823.77 829.47 0.0000 0.0271	33	-8	11	824.43	1.97	2.10	Co-60 826.28
6	844.60 850.30 0.0000 0.0000	92	47	14	846.54	0.27	0.65	Co-56 846.77
7	857.32 863.02	42	-21	14	Could not properly fit the peak.			
8	908.62 914.32 0.0000 0.0000	46	-8	13	911.69	0.27	0.48	Ac-228 911.20
9	965.83 971.97 0.0000 0.0000	38	-1	12	970.00	0.22	0.35	Ac-228 968.97
10	998.71 1004.85 0.0000 0.0004	47	-16	15	1003.20	0.40	0.55	Pa-234M1001.03
11	1060.09 1066.23 match!	34	-10	12	1065.13	0.33	0.53	No close library
12	1118.17 1124.31 0.0000 0.0000	55	21	12	1120.67	0.48	1.05	Bi-214 1120.29
13	1170.34 1176.48 0.0000 0.0000	30	1	10	1173.63	1.10	1.23	Co-60 1173.24
14	1233.24 1241.13 0.0001 0.0000	41	29	9	1238.06	0.29	3.93	Bi-214 1238.11
15	1270.72 1277.29 match!	28	2	10	1271.81	0.22	0.35	No close library
16	1329.88 1336.46	20	-11	10	Could not properly fit the peak.			
17	1457.64 1464.65 0.0001 0.0000	44	33	9	1462.07	0.46	1.66	K-40 1461.00
18	1762.38 1769.83 0.0001 0.0000	44	26	10	1765.53	0.51	0.96	Bi-214 1764.49

MB-11523.Rpt

Detector #1 ACQ 15-Mar-2016 at 16:23:17 RT = 7208.7 LT = 7200.0
 Rad Chem 1
 MB-075

ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
1	607.80 612.63 0.0000 0.0000	118	49	15	609.08	0.53	1.71	Bi-214 609.31
2	660.21 665.47 0.0000 0.0000	59	-4	13	661.96	0.26	0.44	Cs-137 661.66
3	724.23 729.94 0.0000 0.0000	61	11	13	728.58	0.32	0.74	Bi-212 727.00
4	766.11 772.03 0.0001 0.0000	56	23	11	768.30	0.25	0.39	Bi-214 768.36
5	823.77 829.47	42	-21	14	Could not properly fit the peak.			
6	844.60 850.30 0.0000 0.0000	99	81	12	847.54	0.59	1.74	Co-56 846.77
7	857.32 863.02	39	-15	13	Could not properly fit the peak.			
8	908.62 914.32 0.0000 0.0000	48	25	10	911.23	0.69	1.47	Ac-228 911.20
9	965.83 971.97 0.0000 0.0000	50	2	13	969.56	0.22	0.35	Ac-228 968.97
10	998.71 1004.85 0.0004 0.0003	39	15	10	1003.64	0.88	1.14	Pa-234M 1001.03
11	1060.09 1066.23 match!	30	11	9	1062.72	0.22	0.35	No close library
12	1118.17 1124.31 0.0000 0.0000	57	23	12	1120.15	1.83	2.05	Bi-214 1120.29
13	1170.34 1176.48 0.0000 0.0000	34	15	9	1173.63	1.32	1.45	Co-60 1173.24
14	1233.24 1241.13 0.0000 0.0000	51	20	13	1238.72	0.22	0.35	Co-56 1238.28
15	1270.72 1277.29 match!	23	13	7	1271.59	3.84	4.03	No close library
16	1329.88 1336.46	22	-9	10	Could not properly fit the peak.			
17	1457.64 1464.65 0.0002 0.0000	55	49	8	1461.20	1.03	2.37	K-40 1461.00
18	1762.38 1769.83 0.0001 0.0000	38	32	7	1764.87	0.93	1.98	Bi-214 1764.49

MB-11552.Rpt

Detector #1	ACQ	26-Mar-2016 at 18:57:32	RT =	7207.5	LT =	7200.0		
Rad	Chem	1						
MB-086								
ROI#	RANGE(keV)	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
	μCi	$+$ / $-$						
1	607.80 612.63 0.0000 0.0000	128	17	18	609.78	0.51	0.76	Bi-214 609.31
2	660.21 665.47 0.0000 0.0000	60	14	12	661.96	0.22	0.35	Cs-137 661.66
3	724.23 729.94 0.0000 0.0000	43	-7	12	725.33	2.19	2.32	Bi-212 727.00
4	766.11 772.03 0.0001 0.0000	57	15	13	766.99	0.88	1.01	Bi-214 768.36
5	823.77 829.47 0.0123 0.0271	41	5	11	825.97	0.27	0.70	Co-60 826.28
6	844.60 850.30 0.0000 0.0000	101	60	14	847.31	0.48	1.42	Co-56 846.77
7	857.32 863.02	34	-16	12	Could not properly fit the peak.			
8	908.62 914.32 0.0000 0.0000	54	9	12	909.49	1.97	2.10	Ac-228 911.20
9	965.83 971.97 0.0000 0.0000	45	21	10	969.12	0.88	1.01	Ac-228 968.97
10	998.71 1004.85 0.0003 0.0002	30	11	9	1003.10	0.27	0.48	Pa-234M1001.03
11	1060.09 1066.23 match!	24	-10	10	1062.94	0.22	0.35	No close library
12	1118.17 1124.31 0.0000 0.0000	55	26	11	1120.75	0.78	1.47	Bi-214 1120.29
13	1170.34 1176.48	22	3	8	Could not properly fit the peak.			
14	1233.24 1241.13 0.0000 0.0000	39	8	12	1239.16	0.27	0.77	Co-56 1238.28
15	1270.72 1277.29 match!	30	-6	12	1275.10	0.22	0.35	No close library
16	1329.88 1336.46 0.0000 0.0000	25	-1	10	1335.58	0.27	0.48	Co-60 1332.50
17	1457.64 1464.65 0.0001 0.0000	65	43	11	1461.16	0.34	1.58	K-40 1461.00
18	1762.38 1769.83 0.0001 0.0000	41	23	10	1765.56	1.03	1.85	Bi-214 1764.49

MB-11595.Rpt

Detector #1 ACQ 07-Apr-2016 at 11:52:35 RT = 7210.1 LT = 7200.0
 Rad Chem 1
 MB-098

ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
1	607.80 612.63 0.0000 0.0000	114	45	15	610.01	0.36	1.72	Bi-214 609.31
2	660.21 665.47 0.0000 0.0000	70	3	14	661.33	0.29	0.61	Cs-137 661.66
3	724.23 729.94 0.0000 0.0000	57	16	12	727.18	2.11	2.89	Bi-212 727.00
4	766.11 772.03 0.0000 0.0000	55	8	13	768.09	0.26	0.75	Bi-214 768.36
5	823.77 829.47	39	-11	12	Could not properly fit the peak.			
6	844.60 850.30 0.0000 0.0000	74	56	10	847.26	0.35	1.46	Co-56 846.77
7	857.32 863.02 0.0000 0.0000	44	17	10	859.61	2.66	2.89	Tl-208 860.56
8	908.62 914.32 0.0000 0.0000	45	4	12	911.47	0.29	1.27	Ac-228 911.20
9	965.83 971.97 0.0000 0.0000	44	-9	13	969.56	0.22	0.35	Ac-228 968.97
10	998.71 1004.85 0.0000 0.0003	41	-3	12	1000.25	0.22	0.35	Pa-234M 1001.03
11	1060.09 1066.23 match!	40	-8	13	1061.19	1.10	1.23	No close library
12	1118.17 1124.31 0.0000 0.0000	67	23	13	1120.59	0.91	2.41	Bi-214 1120.29
13	1170.34 1176.48 0.0000 0.0000	23	4	8	1172.97	0.27	0.48	Co-60 1173.24
14	1233.24 1241.13 0.0000 0.0000	39	8	12	1238.72	1.31	1.45	Co-56 1238.28
15	1270.72 1277.29 match!	21	-15	11	1276.19	0.22	0.35	No close library
16	1329.88 1336.46 0.0000 0.0000	16	6	6	1331.20	0.27	0.48	Co-60 1332.50
17	1457.64 1464.65 0.0002 0.0000	71	54	11	1461.57	0.83	1.73	K-40 1461.00
18	1762.38 1769.83 0.0001 0.0000	43	31	9	1765.39	0.61	1.95	Bi-214 1764.49



Inter-Mountain Labs

Sheridan, WY and Gillette, WY

- CHAIN OF CUSTODY RECORD -

All shaded fields must be completed.

This is a legal document; any misrepresentation may be construed as fraud.

Page 1 of 1

#WEB

Client Name Environmental Restoration Group (ERG)		Project Identification Midnite Mine		Sampler (Signature/Attestation of Authenticity) Randy Whicker		Telephone # 970-556-1174			
Report Address 8809 Washington St. NE, Suite 150 Albuquerque, NM 87113		Contact Name Randy Whicker		ANALYSES / PARAMETERS					
		Email randywhicker@ergoffice.com							
Invoice Address Same as report address		Phone 970-556-1174		Purchase Order #	Quote # 1265				
ITEM	LAB ID (Lab Use Only)	DATE SAMPLED	SAMPLE IDENTIFICATION	Matrix	# of Containers	REMARKS			
1	51604180-001	03/01/16	CAL1-0015-SOI-COM-01	SL	1	x	Samples previously		
2	002	03/01/16	CAL2-0015-SOI-COM-01	SL	1	x	canned/sealed and		
3	003	03/01/16	CAL3-0015-SOI-COM-01	SL	1	x	analyzed at Energy Labs.		
4	004	03/01/16	CAL4-0015-SOI-COM-01	SL	1	x	Forwarded to IML for		
5	005	03/01/16	CAL5-0015-SOI-COM-01	SL	1	x	gamma-spec only		
6	006	03/01/16	CAL6-0015-SOI-COM-01	SL	1	x	per discussions between		
7	007	03/01/16	CORR1-0015-SOI-COM-01	SL	1	x	Randy Whicker and		
8	008	03/01/16	CORR2-0015-SOI-COM-01	SL	1	x	Tom Patten. Net sample		
9	009	03/01/16	CORR3-0015-SOI-COM-01	SL	1	x	weights / IDs / seal dates		
10	010	03/01/16	CORR4-0015-SOI-COM-01	SL	1	x	listed on lids of cans.		
11							Radon ingrowth already		
12							complete.		
13									
14									
LAB COMMENTS		Relinquished By (Signature/Printed)		DATE	TIME	Received By (Signature/Printed)		DATE	TIME
17.3		David Alvarado DAVID ALVARADO 4-11-16 14:20		Kathy Boyd		4.13.16 10:30			
SHIPPING INFO		MATRIX CODES		TURN AROUND TIMES		COMPLIANCE INFORMATION		ADDITIONAL REMARKS	
<input type="checkbox"/> UPS <input type="checkbox"/> FedEx <input type="checkbox"/> USPS <input type="checkbox"/> Hand Carried <input type="checkbox"/> Other		Water	WT	Check desired service <input checked="" type="checkbox"/> Standard turnaround <input type="checkbox"/> RUSH - 5 Working Days <input type="checkbox"/> URGENT - < 2 Working Days <i>Rush & Urgent Surcharges will be applied</i>		Compliance Monitoring ? N Program (SDWA, NPDES,...) N PWSID / Permit # N Chlorinated? N Sample Disposal: Lab Client x		Ship canned/sealed samples to client after analysis	



Survey Meter # Model 2241-2
pH strip lot # HC54770
Thermometer SN# 27130475

SN#
182115

Condition Upon Receipt (Attach to COC)

Sample Receipt

- 1 Number of ice chests/packages received: 1

Note as "OTC" if samples are received over the counter, unpackaged

- 2 Temperature of cooler/samples. (If more than 8 coolers, please write on back)

Temps Observed (°C): 17.3

Temps Corrected (°C): 1

Acceptable is: 0.1° to 10°C for Bacteria; and 0.1° to 6°C for most other water parameters. Samples may not have had adequate time to cool following collection. Indicate ROI (Received on Ice) for iced samples received on the same day as sampled, in addition to temperature at receipt.

Client contact for temperatures outside method criteria must be documented below.

- 3 Emission rate of samples for radiochemical analyses < 0.5mR/hr? Yes No N/A
- 4 COC Number (If applicable): WCB
- 5 Do the number of bottles agree with the COC? Yes No N/A
- 6 Were the samples received intact? (no broken bottles, leaks, etc.) Yes No N/A
- 7 Were the sample custody seals intact? Yes No N/A
- 8 Is the COC properly completed, legible, and signed? Yes No

Sample Verification, Labeling & Distribution

- 1 Were all requested analyses understood and appropriate? Yes No
- 2 Did the bottle labels correspond with the COC information? Yes No
- 3 Samples collected in proper containers? Yes No
- 4 Sample Preservation:

pH at Receipt:	Final pH (if added in lab):	Preservative/Lot#	Date/Time Added:
_____ Total Metals	_____ Total Metals	HNO3 _____	_____
_____ Diss Metals	_____ Diss Metals	Filtered and preserved in metals	Filtered and preserved in metals
_____ Nutrient	_____ Nutrient	H ₂ SO ₄ _____	_____
_____ Cyanide	_____ Cyanide	NaOH _____	_____
_____ Sulfide	_____ Sulfide	ZnAcet _____	_____
_____ Phenol	_____ Phenol	H ₂ SO ₄ _____	_____
_____ TOC	_____ TOC	HCl _____	_____

pH of each WY STP (LAUST) sample must be checked and recorded.

- 5 VOA vials have <6mm headspace? Yes No N/A
- 6 Were all analyses within holding time at the time of receipt? Yes No N/A
- 7 Have rush or project due dates been checked and accepted? Yes No N/A
- 8 Do samples require subcontracted analyses? Yes No

If "Yes", which type of subcontracting is required? General Customer-Specified Certified

Sample Receipt, Verification, Login, Labeling & Distribution completed by (initials): KB

Set ID: 51604180

Discrepancy Documentation (use back of sheet for notes on discrepancies)

Any items listed above with a response of "No" or do not meet specifications must be resolved.

Person Contacted: Randy W/ ERG Method of Contact: Phone: _____

Initiated By: KB Date/Time: 4/13-16 X Email: _____

Problem: E-mailed Randy 10:41 to let him know samples arrived intact

Resolution:



Report Review Checklist

COC Review Information on COC matches that on report; spelling accurate.

		Log Review	Report Review
1	Original COC attached, signed and dated.	✓	✓
2	Parameters requested.	✓	✓
3	Client.	✓	✓
4	Report recipient/address.	✓	✓
5	Invoice recipient/address.	✓	✓
6	Project.	✓	✓
7	Appropriate PQLs selected.	✓	✓
8	Prices may need to be adjusted prior to invoicing.	Quote	Yes or No
9	P. O. number.	— ✓ —	✓
10	Sample IDs.	✓	NA
11	Sample dates.	✓	✓
12	Date received.	✓	✓
13	Date due.	✓	✓
14	Matrix.	✓	✓
15	PWSID included for safe drinking water compliance samples.	—	NA
16	Field data entered appropriately, matches lab data.	—	NA
17	Special requests indicated in "Comments" section of Work Order summary.	—	✓

Data Review

		WN 4-19-16
1	Automated QC (Check Data button) review performed, discrepancies resolved.	✓
2	Worksheet/instrument data sheet for all requested parameters attached to data packet.	✓
3	Worksheet/instrument data sheet initialed and dated by analyst, indicating review.	✓
4	Worksheet/instrument data compared to report results for calculation, transcription and data entry errors.	✓
5	Analysis date and time.	✓
6	Analytical method.	✓
7	Appropriate units of measure.	✓
8	Analyst's initials.	✓
9	Calculations checked?	✓
10	Subcontracted analyses identified as such with qualifier.	NA
11	Invoice parameters match those on COC.	✓

Final Review

		WN 4-19-16
1	Report appears complete and appropriate.	✓
2	Condition Upon Receipt form completed, attached to packet, and related qualifiers included in report.	✓
3	All necessary qualifiers included in report.	✓
4	Qualifiers referenced in case narrative; which includes descriptions of all sample/analysis anomalies.	✓
5	Anomalies explained in Case Narrative.	✓
6	Copies of report sent to all recipients requested on COC.	Hard copies. NA Emailed copies.
7	All special requests listed on COC honored.	✓
8	Special report format per client request.	✓
9	Report pages signed.	✓



Inter-Mountain Labs

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Date: 7/13/2016

CLIENT: Dawn Mining Company
Project: Midnite Mine
Lab Order: S1607021

CASE NARRATIVE

Report ID: S1607021001

This report contains:

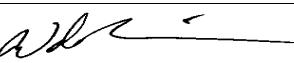
Case Narrative - 1 page
Sample Analysis Report - 11 pages
Analytical QC Summary Report - 1 page
Gamma Spec LIMS Report and Export File - 2 pages
Gamma Spec Ra 226 Spectrum and ROI Data - 34 pages
Gamma Spec Ra 226 Standards Certificates - 17 pages
Gamma Spec Ra 226 ROI Calibration and Blanks - 18 pages
Original COC, Condition Upon Receipt and Supporting Documentation - 4 page

Samples CORR10-0015-SOI-DIS-01, CORR11-0015-SOI-DIS-01, CORR12-0015-SOI-DIS-01, CORR13-0015-SOI-DIS-01, CORR14-0015-SOI-DIS-01, CORR15-0015-SOI-DIS-01, CORR5-0015-SOI-DIS-01, CORR6-0015-SOI-DIS-01, CORR7-0015-SOI-DIS-01, CORR8-0015-SOI-DIS-01, and CORR9-0015-SOI-DIS-01 were received on July 5, 2016. .

All samples were received and analyzed within the EPA recommended holding times, except those noted below in this case narrative. Samples were analyzed using the methods outlined in the following references:

U.S.E.P.A. 600 "Methods for Chemical Analysis of Water and Wastes", 1993
"Standard Methods For The Examination of Water and Wastewater", 20th ed., 1998
Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, 3rd Edition
Methods indicated with the Monday, March 12, 2007 Federal Register, 40 CFR Part 122, 136 et al.
US EPA Methods from Technology Transfer Network Ambient Monitoring Technology Information Center, 2009

All Quality objectives were achieved except as noted below:

Reviewed by: 

Wade Nieuwsma, Assistant Laboratory Manager

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Inter-Mountain Labs

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Sample Analysis Report

Company: Dawn Mining Company
8809 Washington St. NE. Suite 150
Albuquerque, NM 87113 **Date Reported:** 7/13/2016
Report ID: S1607021001

ProjectName: Midnite Mine **WorkOrder:** S1607021
Lab ID: S1607021-001 **CollectionDate:** 6/6/2016 1:20:00 PM
ClientSample ID: CORR5-0015-SOI-DIS-01 **DateReceived:** 7/5/2016 9:55:00 AM
COC: WEB **FieldSampler:** DWA
Matrix: Soil

Comments

Analyses	Result	Units	Qual	RL	Method	Date Analyzed/Init
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Radionuclides - Total

Radium 226	2.3	pCi/g		0.2	E901.1 Mod.	07/05/2016 1432	MB
Radium 226 Precision (\pm)	0.2	pCi/g			E901.1 Mod.	07/05/2016 1432	MB

These results apply only to the samples tested.**RL - Reporting Limit**

Qualifiers:	B Analyte detected in the associated Method Blank	C Calculated Value
E Value above quantitation range	H Holding times for preparation or analysis exceeded	
J Analyte detected below quantitation limits	L Analyzed by another laboratory	
M Value exceeds Monthly Ave or MCL or is less than LCL	ND Not Detected at the Reporting Limit	
O Outside the Range of Dilutions	S Spike Recovery outside accepted recovery limits	
X Matrix Effect		

Reviewed by:

Wade Nieuwsma, Assistant Laboratory Manager

Page 1 of 11



Inter-Mountain Labs

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Sample Analysis Report

Company:	Dawn Mining Company 8809 Washington St. NE. Suite 150 Albuquerque, NM 87113	Date Reported	7/13/2016
		Report ID	S1607021001
ProjectName:	Midnite Mine	WorkOrder:	S1607021
Lab ID:	S1607021-002	CollectionDate:	6/6/2016 1:32:00 PM
ClientSample ID:	CORR6-0015-SOI-DIS-01	DateReceived:	7/5/2016 9:55:00 AM
COC:	WEB	FieldSampler:	DWA
		Matrix:	Soil

Comments

Analyses	Result	Units	Qual	RL	Method	Date Analyzed/Init
Radionuclides - Total						
Radium 226	3.1	pCi/g		0.2	E901.1 Mod.	07/05/2016 1549 MB
Radium 226 Precision (\pm)	0.2	pCi/g			E901.1 Mod.	07/05/2016 1549 MB

These results apply only to the samples tested.**RL - Reporting Limit**

Qualifiers:	B Analyte detected in the associated Method Blank	C Calculated Value
E Value above quantitation range	H Holding times for preparation or analysis exceeded	
J Analyte detected below quantitation limits	L Analyzed by another laboratory	
M Value exceeds Monthly Ave or MCL or is less than LCL	ND Not Detected at the Reporting Limit	
O Outside the Range of Dilutions	S Spike Recovery outside accepted recovery limits	
X Matrix Effect		

Reviewed by:

Wade Nieuwsma, Assistant Laboratory Manager

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Inter-Mountain Labs

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Sample Analysis Report

Company:	Dawn Mining Company 8809 Washington St. NE. Suite 150 Albuquerque, NM 87113	Date Reported	7/13/2016
		Report ID	S1607021001
ProjectName:	Midnite Mine	WorkOrder:	S1607021
Lab ID:	S1607021-003	CollectionDate:	6/6/2016 1:44:00 PM
ClientSample ID:	CORR7-0015-SOI-DIS-01	DateReceived:	7/5/2016 9:55:00 AM
COC:	WEB	FieldSampler:	DWA
		Matrix:	Soil

Comments

Analyses	Result	Units	Qual	RL	Method	Date Analyzed/Init
Radionuclides - Total						
Radium 226	1.7	pCi/g		0.2	E901.1 Mod.	07/05/2016 1706 MB
Radium 226 Precision (\pm)	0.2	pCi/g			E901.1 Mod.	07/05/2016 1706 MB

These results apply only to the samples tested.**RL - Reporting Limit**

Qualifiers:	B Analyte detected in the associated Method Blank	C Calculated Value
E Value above quantitation range	H Holding times for preparation or analysis exceeded	
J Analyte detected below quantitation limits	L Analyzed by another laboratory	
M Value exceeds Monthly Ave or MCL or is less than LCL	ND Not Detected at the Reporting Limit	
O Outside the Range of Dilutions	S Spike Recovery outside accepted recovery limits	
X Matrix Effect		

Reviewed by:

Wade Nieuwsma, Assistant Laboratory Manager

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Inter-Mountain Labs

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Sample Analysis Report

Company: Dawn Mining Company
8809 Washington St. NE. Suite 150
Albuquerque, NM 87113 **Date Reported:** 7/13/2016
Report ID: S1607021001

ProjectName: Midnite Mine **WorkOrder:** S1607021
Lab ID: S1607021-004 **CollectionDate:** 6/6/2016 1:55:00 PM
ClientSample ID: CORR8-0015-SOI-DIS-01 **DateReceived:** 7/5/2016 9:55:00 AM
COC: WEB **FieldSampler:** DWA
Matrix: Soil

Comments

Analyses	Result	Units	Qual	RL	Method	Date Analyzed/Init	
Radionuclides - Total							
Radium 226	3.5	pCi/g		0.2	E901.1 Mod.	07/05/2016 1824	MB
Radium 226 Precision (\pm)	0.2	pCi/g			E901.1 Mod.	07/05/2016 1824	MB

These results apply only to the samples tested.**RL - Reporting Limit**

Qualifiers: B Analyte detected in the associated Method Blank
E Value above quantitation range
J Analyte detected below quantitation limits
M Value exceeds Monthly Ave or MCL or is less than LCL
O Outside the Range of Dilutions
X Matrix Effect

C Calculated Value
H Holding times for preparation or analysis exceeded
L Analyzed by another laboratory
ND Not Detected at the Reporting Limit
S Spike Recovery outside accepted recovery limits

Reviewed by: A. Nieuwsma

Wade Nieuwsma, Assistant Laboratory Manager

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Inter-Mountain Labs

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Sample Analysis Report

Company: Dawn Mining Company
8809 Washington St. NE. Suite 150
Albuquerque, NM 87113 **Date Reported:** 7/13/2016
Report ID: S1607021001

ProjectName: Midnite Mine **WorkOrder:** S1607021
Lab ID: S1607021-005 **CollectionDate:** 6/6/2016 2:19:00 PM
ClientSample ID: CORR9-0015-SOI-DIS-01 **DateReceived:** 7/5/2016 9:55:00 AM
COC: WEB **FieldSampler:** DWA
Matrix: Soil

Comments

Analyses	Result	Units	Qual	RL	Method	Date Analyzed/Init
Radionuclides - Total						
Radium 226	2.2	pCi/g		0.2	E901.1 Mod.	07/05/2016 2010 MB
Radium 226 Precision (\pm)	0.2	pCi/g			E901.1 Mod.	07/05/2016 2010 MB

These results apply only to the samples tested.**RL - Reporting Limit**

Qualifiers: B Analyte detected in the associated Method Blank
E Value above quantitation range
J Analyte detected below quantitation limits
M Value exceeds Monthly Ave or MCL or is less than LCL
O Outside the Range of Dilutions
X Matrix Effect

C Calculated Value
H Holding times for preparation or analysis exceeded
L Analyzed by another laboratory
ND Not Detected at the Reporting Limit
S Spike Recovery outside accepted recovery limits

Reviewed by:

Wade Nieuwsma, Assistant Laboratory Manager

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Inter-Mountain Labs

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Sample Analysis Report

Company:	Dawn Mining Company 8809 Washington St. NE. Suite 150 Albuquerque, NM 87113	Date Reported	7/13/2016
		Report ID	S1607021001
ProjectName:	Midnite Mine	WorkOrder:	S1607021
Lab ID:	S1607021-006	CollectionDate:	6/6/2016 2:43:00 PM
ClientSample ID:	CORR10-0015-SOI-DIS-01	DateReceived:	7/5/2016 9:55:00 AM
COC:	WEB	FieldSampler:	DWA
		Matrix:	Soil

Comments

Analyses	Result	Units	Qual	RL	Method	Date Analyzed/Init
Radionuclides - Total						
Radium 226	1.3	pCi/g		0.2	E901.1 Mod.	07/05/2016 2337 MB
Radium 226 Precision (\pm)	0.2	pCi/g			E901.1 Mod.	07/05/2016 2337 MB

These results apply only to the samples tested.**RL - Reporting Limit**

Qualifiers:	B Analyte detected in the associated Method Blank	C Calculated Value
E Value above quantitation range	H Holding times for preparation or analysis exceeded	
J Analyte detected below quantitation limits	L Analyzed by another laboratory	
M Value exceeds Monthly Ave or MCL or is less than LCL	ND Not Detected at the Reporting Limit	
O Outside the Range of Dilutions	S Spike Recovery outside accepted recovery limits	
X Matrix Effect		

Reviewed by:

Wade Nieuwsma, Assistant Laboratory Manager

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Inter-Mountain Labs

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Your Environmental Monitoring Partner

Sample Analysis Report

Company:	Dawn Mining Company 8809 Washington St. NE. Suite 150 Albuquerque, NM 87113	Date Reported	7/13/2016
		Report ID	S1607021001
ProjectName:	Midnite Mine	WorkOrder:	S1607021
Lab ID:	S1607021-007	CollectionDate:	6/6/2016 3:13:00 PM
ClientSample ID:	CORR11-0015-SOI-DIS-01	DateReceived:	7/5/2016 9:55:00 AM
COC:	WEB	FieldSampler:	DWA
		Matrix:	Soil

Comments

Analyses	Result	Units	Qual	RL	Method	Date Analyzed/Init
Radionuclides - Total						
Radium 226	16.9	pCi/g		0.2	E901.1 Mod.	07/06/2016 811 MB
Radium 226 Precision (\pm)	0.5	pCi/g			E901.1 Mod.	07/06/2016 811 MB

These results apply only to the samples tested.**RL - Reporting Limit**

Qualifiers:	B Analyte detected in the associated Method Blank	C Calculated Value
E Value above quantitation range	H Holding times for preparation or analysis exceeded	
J Analyte detected below quantitation limits	L Analyzed by another laboratory	
M Value exceeds Monthly Ave or MCL or is less than LCL	ND Not Detected at the Reporting Limit	
O Outside the Range of Dilutions	S Spike Recovery outside accepted recovery limits	
X Matrix Effect		

Reviewed by:

Wade Nieuwsma, Assistant Laboratory Manager

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Inter-Mountain Labs

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Sample Analysis Report

Company: Dawn Mining Company
8809 Washington St. NE. Suite 150
Albuquerque, NM 87113 **Date Reported:** 7/13/2016
Report ID: S1607021001

ProjectName: Midnite Mine **WorkOrder:** S1607021
Lab ID: S1607021-008 **CollectionDate:** 6/7/2016 10:31:00 AM
ClientSample ID: CORR12-0015-SOI-DIS-01 **DateReceived:** 7/5/2016 9:55:00 AM
COC: WEB **FieldSampler:** DWA
Matrix: Soil

Comments

Analyses	Result	Units	Qual	RL	Method	Date Analyzed/Init
Radionuclides - Total						
Radium 226	4.5	pCi/g		0.2	E901.1 Mod.	07/06/2016 927 MB
Radium 226 Precision (\pm)	0.3	pCi/g			E901.1 Mod.	07/06/2016 927 MB

These results apply only to the samples tested.**RL - Reporting Limit**

Qualifiers:	B Analyte detected in the associated Method Blank	C Calculated Value
E Value above quantitation range	H Holding times for preparation or analysis exceeded	
J Analyte detected below quantitation limits	L Analyzed by another laboratory	
M Value exceeds Monthly Ave or MCL or is less than LCL	ND Not Detected at the Reporting Limit	
O Outside the Range of Dilutions	S Spike Recovery outside accepted recovery limits	
X Matrix Effect		

Reviewed by:

Wade Nieuwsma, Assistant Laboratory Manager

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Inter-Mountain Labs

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Sample Analysis Report

Company: Dawn Mining Company
8809 Washington St. NE. Suite 150
Albuquerque, NM 87113 **Date Reported:** 7/13/2016
Report ID: S1607021001

ProjectName: Midnite Mine **WorkOrder:** S1607021
Lab ID: S1607021-009 **CollectionDate:** 6/7/2016 10:43:00 AM
ClientSample ID: CORR13-0015-SOI-DIS-01 **DateReceived:** 7/5/2016 9:55:00 AM
COC: WEB **FieldSampler:** DWA
Matrix: Soil

Comments

Analyses	Result	Units	Qual	RL	Method	Date Analyzed/Init
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Radionuclides - Total

Radium 226	5.0	pCi/g	0.2	E901.1 Mod.	07/06/2016 1045	MB
Radium 226 Precision (\pm)	0.3	pCi/g		E901.1 Mod.	07/06/2016 1045	MB

These results apply only to the samples tested.**RL - Reporting Limit**

Qualifiers:	B Analyte detected in the associated Method Blank	C Calculated Value
E Value above quantitation range	H Holding times for preparation or analysis exceeded	
J Analyte detected below quantitation limits	L Analyzed by another laboratory	
M Value exceeds Monthly Ave or MCL or is less than LCL	ND Not Detected at the Reporting Limit	
O Outside the Range of Dilutions	S Spike Recovery outside accepted recovery limits	
X Matrix Effect		

Reviewed by:

Wade Nieuwsma, Assistant Laboratory Manager

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Inter-Mountain Labs

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Sample Analysis Report

Company: Dawn Mining Company
8809 Washington St. NE. Suite 150
Albuquerque, NM 87113 **Date Reported:** 7/13/2016
Report ID: S1607021001

ProjectName: Midnite Mine **WorkOrder:** S1607021
Lab ID: S1607021-010 **CollectionDate:** 6/7/2016 10:59:00 AM
ClientSample ID: CORR14-0015-SOI-DIS-01 **DateReceived:** 7/5/2016 9:55:00 AM
COC: WEB **FieldSampler:** DWA
Matrix: Soil

Comments

Analyses	Result	Units	Qual	RL	Method	Date Analyzed/Init	
Radionuclides - Total							
Radium 226	16.6	pCi/g		0.2	E901.1 Mod.	07/06/2016 1202	MB
Radium 226 Precision (\pm)	0.5	pCi/g			E901.1 Mod.	07/06/2016 1202	MB

These results apply only to the samples tested.**RL - Reporting Limit**

Qualifiers: B Analyte detected in the associated Method Blank
E Value above quantitation range
J Analyte detected below quantitation limits
M Value exceeds Monthly Ave or MCL or is less than LCL
O Outside the Range of Dilutions
X Matrix Effect

C Calculated Value
H Holding times for preparation or analysis exceeded
L Analyzed by another laboratory
ND Not Detected at the Reporting Limit
S Spike Recovery outside accepted recovery limits

Reviewed by: A. Nieuwsma

Wade Nieuwsma, Assistant Laboratory Manager

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Inter-Mountain Labs

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Sample Analysis Report

Company: Dawn Mining Company
8809 Washington St. NE. Suite 150
Albuquerque, NM 87113 **Date Reported:** 7/13/2016
Report ID: S1607021001

ProjectName: Midnite Mine **WorkOrder:** S1607021
Lab ID: S1607021-011 **CollectionDate:** 6/7/2016 11:20:00 AM
ClientSample ID: CORR15-0015-SOI-DIS-01 **DateReceived:** 7/5/2016 9:55:00 AM
COC: WEB **FieldSampler:** DWA
Matrix: Soil

Comments

Analyses	Result	Units	Qual	RL	Method	Date Analyzed/Init
Radionuclides - Total						
Radium 226	21.0	pCi/g		0.2	E901.1 Mod.	07/06/2016 1416 MB
Radium 226 Precision (\pm)	0.5	pCi/g			E901.1 Mod.	07/06/2016 1416 MB

These results apply only to the samples tested.**RL - Reporting Limit**

Qualifiers:	B Analyte detected in the associated Method Blank	C Calculated Value
E Value above quantitation range	H Holding times for preparation or analysis exceeded	
J Analyte detected below quantitation limits	L Analyzed by another laboratory	
M Value exceeds Monthly Ave or MCL or is less than LCL	ND Not Detected at the Reporting Limit	
O Outside the Range of Dilutions	S Spike Recovery outside accepted recovery limits	
X Matrix Effect		

Reviewed by: A. Nieuwsma

Wade Nieuwsma, Assistant Laboratory Manager

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Inter-Mountain Labs

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

ANALYTICAL QC SUMMARY REPORT

CLIENT: Dawn Mining Company
Work Order: S1607021
Project: Midnite Mine

Date: 7/13/2016**Report ID:** S1607021001

Radium By Gamma Spectroscopy in Soil

Sample Type **MBLK**

Units: pCi/g

MB-11954 (07/05/16 11:44)	RunNo: 136007	PrepDate: 06/07/16 12:00	BatchID: 11954				
Analyte	Result	RL	Spike	Ref Samp	%REC	% Rec Limits	Qual
Radium 226	ND	0.2					

Radium By Gamma Spectroscopy in Soil

Sample Type **LCS**

Units: pCi/g

LCS-11954 (07/05/16 13:06)	RunNo: 136007	PrepDate: 06/07/16 12:00	BatchID: 11954				
Analyte	Result	RL	Spike	Ref Samp	%REC	% Rec Limits	Qual
Radium 226	36.9	0.2	37.9		97.3	70 - 130	

ROCKYFLATS (07/06/16 16:54)

RunNo: 136007 PrepDate: 06/07/16 12:00 BatchID: 11954

Analyte

Result RL Spike Ref Samp %REC % Rec Limits Qual

Radium 226

1.2 0.2 1.15 102 70 - 130

UTS-4 (07/06/16 23:07)

RunNo: 136007 PrepDate: 06/07/16 12:00 BatchID: 11954

Analyte

Result RL Spike Ref Samp %REC % Rec Limits Qual

Radium 226

842 0.2 978 86.1 70 - 130

Radium By Gamma Spectroscopy in Soil

Sample Type **DUP**

Units: pCi/g

S1607021-011AD (07/06/16 15:34)	RunNo: 136007	PrepDate: 06/08/16 12:00	BatchID: 11954				
Analyte	Result	RL	Ref Samp	%RPD	%REC	% RPD Limits	Qual
Radium 226	20.8	0.2	21.0	0.862		20	

Qualifiers: B Analyte detected in the associated Method Blank
H Holding times for preparation or analysis exceeded
L Analyzed by another laboratory
O Outside the Range of Dilutions
S Spike Recovery outside accepted recovery limits

E Value above quantitation range
J Analyte detected below quantitation limits
ND Not Detected at the Reporting Limit
R RPD outside accepted recovery limits
X Matrix Effect

Radium Analysis by Gamma Spectroscopy

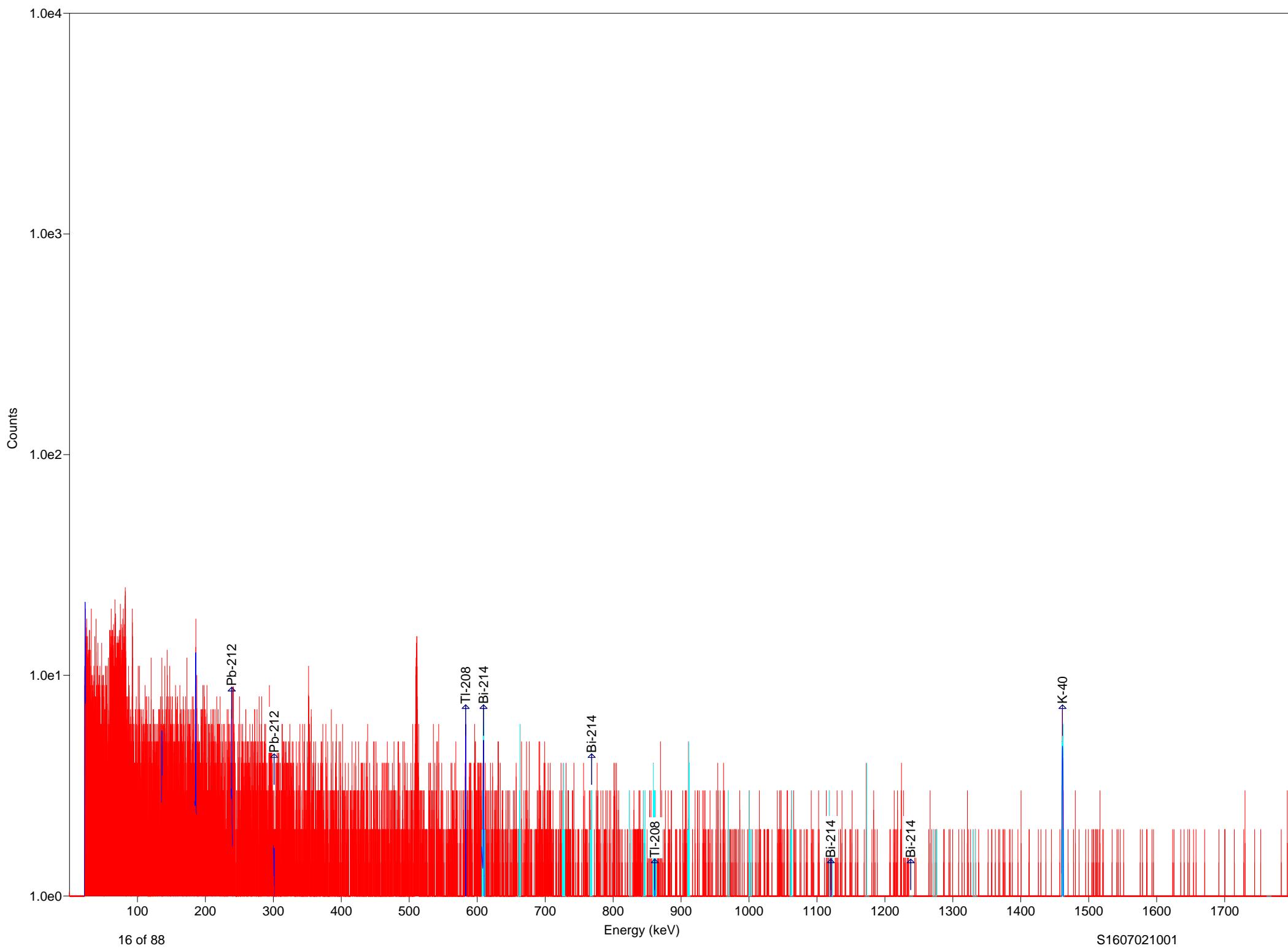
Instrument Batch: 16-17

Omega Run 136007

SampID	SampID	SampID	Analyte	Text Rslt	Counts	Error	Time	Result	95% CI	Weight	Samp Type	Prep
MB-187	7/5/16 11:44	RAD_GAMMA_RA_S	Radium 226		11	12	4500	-0.10	0.09	150	MBLK	11954
LCS-187	7/5/16 13:06	RAD_GAMMA_RA_S	Radium 226		9984	107	4500	36.89	0.77	150.02	LCS	11954
S1607021-001A	7/5/16 14:32	RAD_GAMMA_RA_S	Radium 226	2.3 ± 0.2	844	35	4500	2.25	0.19	198.61	SAMP	11954
S1607021-002A	7/5/16 15:49	RAD_GAMMA_RA_S	Radium 226	3.1 ± 0.2	1087	38	4500	3.10	0.22	187.99	SAMP	11954
S1607021-003A	7/5/16 17:06	RAD_GAMMA_RA_S	Radium 226	1.7 ± 0.2	625	32	4500	1.72	0.18	189.04	SAMP	11954
S1607021-004A	7/5/16 18:24	RAD_GAMMA_RA_S	Radium 226	3.5 ± 0.2	1043	37	4500	3.47	0.25	160.82	SAMP	11954
S1607021-005A	7/5/16 20:10	RAD_GAMMA_RA_S	Radium 226	2.2 ± 0.2	722	33	4500	2.19	0.21	173.46	SAMP	11954
S1607021-006A	7/5/16 23:37	RAD_GAMMA_RA_S	Radium 226	1.3 ± 0.2	341	23	4500	1.30	0.19	128.78	SAMP	11954
S1607021-007A	7/6/16 8:11	RAD_GAMMA_RA_S	Radium 226	16.9 ± 0.5	5702	80	4500	16.93	0.47	186.16	SAMP	11954
S1607021-008A	7/6/16 9:27	RAD_GAMMA_RA_S	Radium 226	4.5 ± 0.3	1514	43	4500	4.52	0.26	181.41	SAMP	11954
S1607021-009A	7/6/16 10:45	RAD_GAMMA_RA_S	Radium 226	5.0 ± 0.3	1617	45	4500	4.99	0.28	176.03	SAMP	11954
S1607021-010A	7/6/16 12:02	RAD_GAMMA_RA_S	Radium 226	16.6 ± 0.5	5517	80	4500	16.57	0.47	183.92	SAMP	11954
S1607021-011A	7/6/16 14:16	RAD_GAMMA_RA_S	Radium 226	21.0 ± 0.5	6800	89	4500	20.95	0.54	179.56	SAMP	11954
S1607021-011AD	7/6/16 15:34	RAD_GAMMA_RA_S	Radium 226		6742	88	4500	20.77	0.53	179.56	DUP	11954
ROCKYFLATS	7/6/16 16:54	RAD_GAMMA_RA_S	Radium 226		195	20	4500	1.17	0.29	74.21	LCS	11954
UTS-4	7/6/16 23:07	RAD_GAMMA_RA_S	Radium 226		7608	93	4500	842.38	20.18	5	LCS	11954

Reviewed By MRC 7/7/16

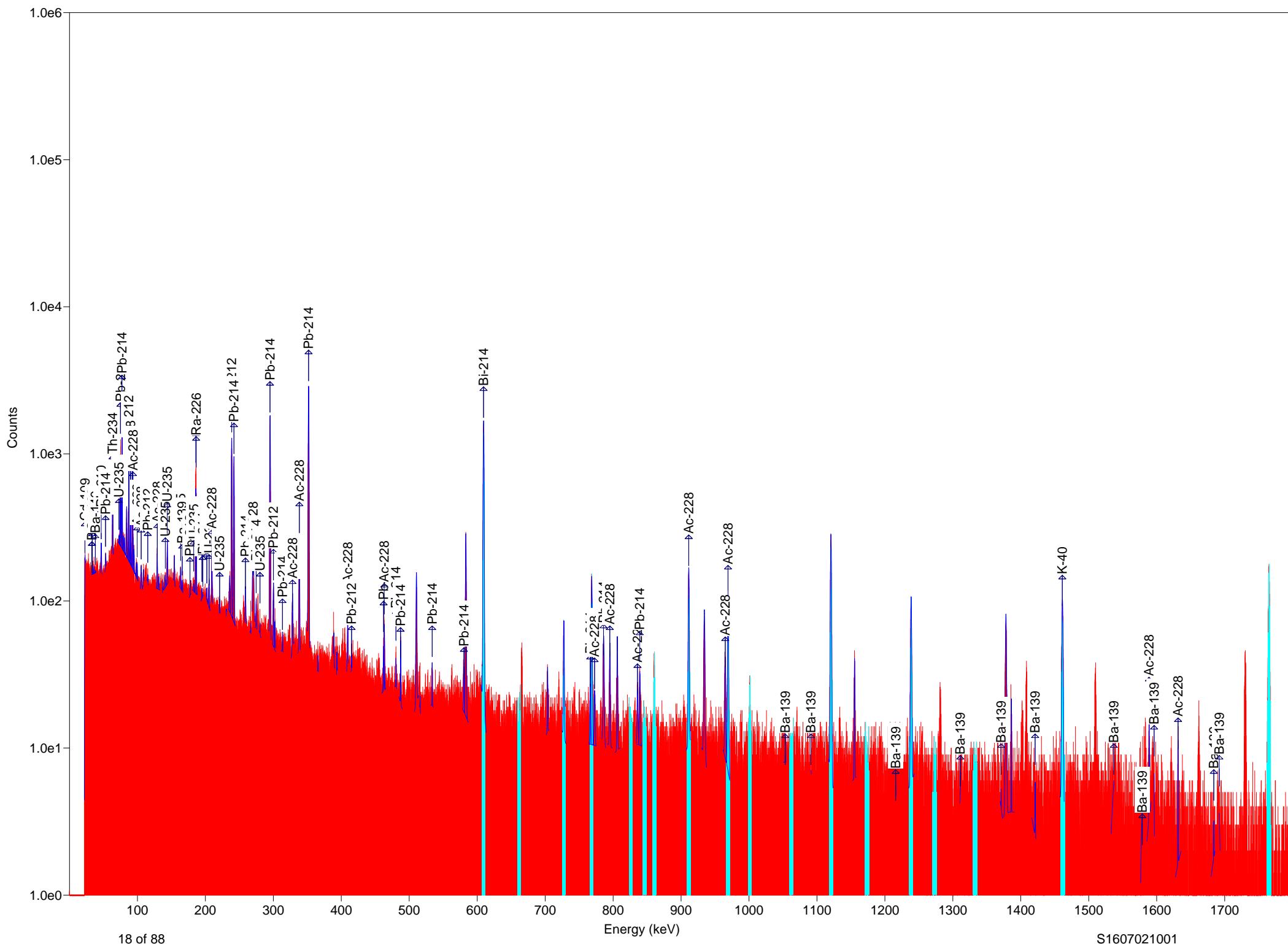
LCS-187	LCS	RAD_GAMMA_R	7/5/2016 13:06	Radium 226	36.88925 pCi/g		1	0 LCS-11954
MB-187	MBLK	RAD_GAMMA_R	7/5/2016 11:44	Radium 226	-0.10469 pCi/g		1	0 MB-11954
ROCKYFLATS	LCS	RAD_GAMMA_R	7/6/2016 16:54	Radium 226	1.168171 pCi/g		1	0 ROCKYFLATS
S1607021-001A	SAMP	RAD_GAMMA_R	7/5/2016 14:32	Radium 226	2.254917 pCi/g	2.3 ± 0.2	1	1 S1607021-001A
S1607021-002A	SAMP	RAD_GAMMA_R	7/5/2016 15:49	Radium 226	3.101627 pCi/g	3.1 ± 0.2	1	1 S1607021-002A
S1607021-003A	SAMP	RAD_GAMMA_R	7/5/2016 17:06	Radium 226	1.72439 pCi/g	1.7 ± 0.2	1	1 S1607021-003A
S1607021-004A	SAMP	RAD_GAMMA_R	7/5/2016 18:24	Radium 226	3.473384 pCi/g	3.5 ± 0.2	1	1 S1607021-004A
S1607021-005A	SAMP	RAD_GAMMA_R	7/5/2016 20:10	Radium 226	2.190463 pCi/g	2.2 ± 0.2	1	1 S1607021-005A
S1607021-006A	SAMP	RAD_GAMMA_R	7/5/2016 23:37	Radium 226	1.30406 pCi/g	1.3 ± 0.2	1	1 S1607021-006A
S1607021-007A	SAMP	RAD_GAMMA_R	7/6/2016 8:11	Radium 226	16.92767 pCi/g	16.9 ± 0.5	1	1 S1607021-007A
S1607021-008A	SAMP	RAD_GAMMA_R	7/6/2016 9:27	Radium 226	4.523974 pCi/g	4.5 ± 0.3	1	1 S1607021-008A
S1607021-009A	SAMP	RAD_GAMMA_R	7/6/2016 10:45	Radium 226	4.987855 pCi/g	5.0 ± 0.3	1	1 S1607021-009A
S1607021-010A	SAMP	RAD_GAMMA_R	7/6/2016 12:02	Radium 226	16.57408 pCi/g	16.6 ± 0.5	1	1 S1607021-010A
S1607021-011A	SAMP	RAD_GAMMA_R	7/6/2016 14:16	Radium 226	20.95275 pCi/g	21.0 ± 0.5	1	1 S1607021-011A
S1607021-011AD	DUP	RAD_GAMMA_R	7/6/2016 15:34	Radium 226	20.773 pCi/g		1	0 S1607021-011A
UTS-4	LCS	RAD_GAMMA_R	7/6/2016 23:07	Radium 226	842.3832 pCi/g		1	0 UTS-4



MB-187.Rpt

Detector #2 ACQ 05-Jul-2016 at 11:44:47 RT = 4508.7 LT = 4500.0
 Rad Chem 2
 MB-187

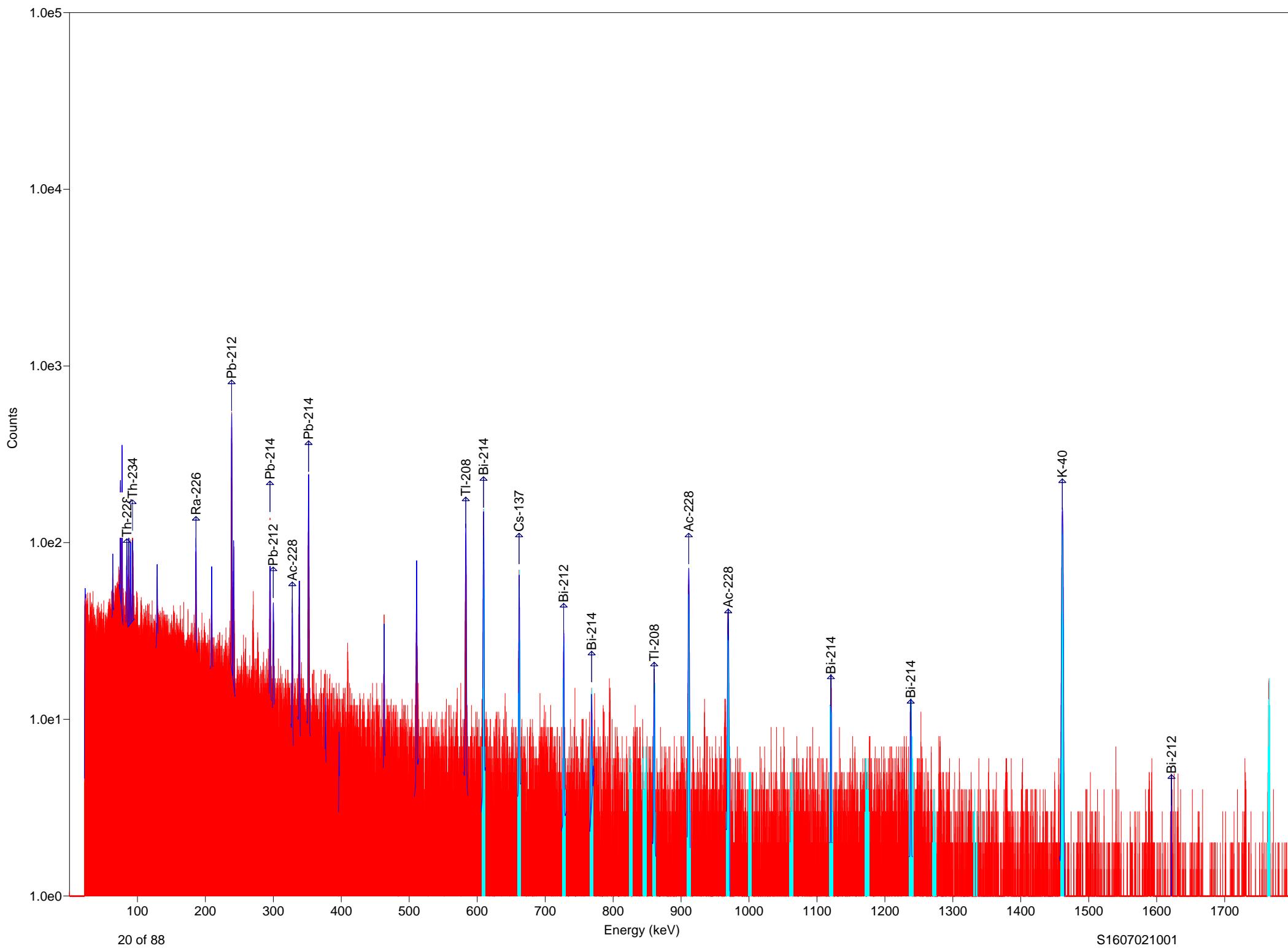
ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
1	606.93 611.75 0.0000 0.0000	61	11	12	609.03	0.88	1.45	Bi-214 609.31
2	659.29 664.11 0.0000 0.0000	32	9	8	663.02	0.25	0.39	Cs-137 661.66
3	724.58 729.84 0.0000 0.0000	28	-5	10	726.55	0.22	0.35	Bi-212 727.00
4	765.77 771.02 0.0000 0.0000	18	-3	7	767.30	1.20	1.40	Bi-214 768.36
5	823.38 828.64	19	-10	9	Could not properly fit the peak.			
6	843.53 848.79 0.0000 0.0000	26	1	8	844.19	3.07	3.20	Co-56 846.77
7	857.99 863.25 0.0000 0.0000	27	2	9	858.87	0.22	0.35	Tl-208 860.56
8	908.38 914.07 0.0000 0.0000	30	16	7	910.79	0.25	0.39	Ac-228 911.20
9	966.21 971.90 0.0000 0.0000	25	-2	9	969.05	0.33	0.74	Ac-228 968.97
10	998.19 1003.88 0.0004 0.0003	18	9	6	999.94	0.22	0.35	Pa-234M 1001.03
11	1059.08 1065.21 match!	18	8	6	1062.46	0.54	0.85	No close library
12	1117.34 1123.47 0.0000 0.0000	22	7	7	1118.00	0.22	0.35	Bi-214 1120.29
13	1170.34 1176.47 0.0000 0.0000	15	0	7	1172.31	0.26	0.44	Co-60 1173.24
14	1235.17 1241.30	9	-1	6	Could not properly fit the peak.			
15	1269.55 1276.12 match!	17	-4	9	1271.08	0.33	0.53	No close library
16	1329.34 1335.91 0.0000 0.0000	11	-5	7	1332.84	0.22	0.35	Co-60 1332.50
17	1457.88 1464.45 0.0002 0.0000	55	45	9	1460.86	2.23	2.86	K-40 1461.00
18	1761.13 1768.13	9	9	3	Could not properly fit the peak.			



LCS-187.Rpt

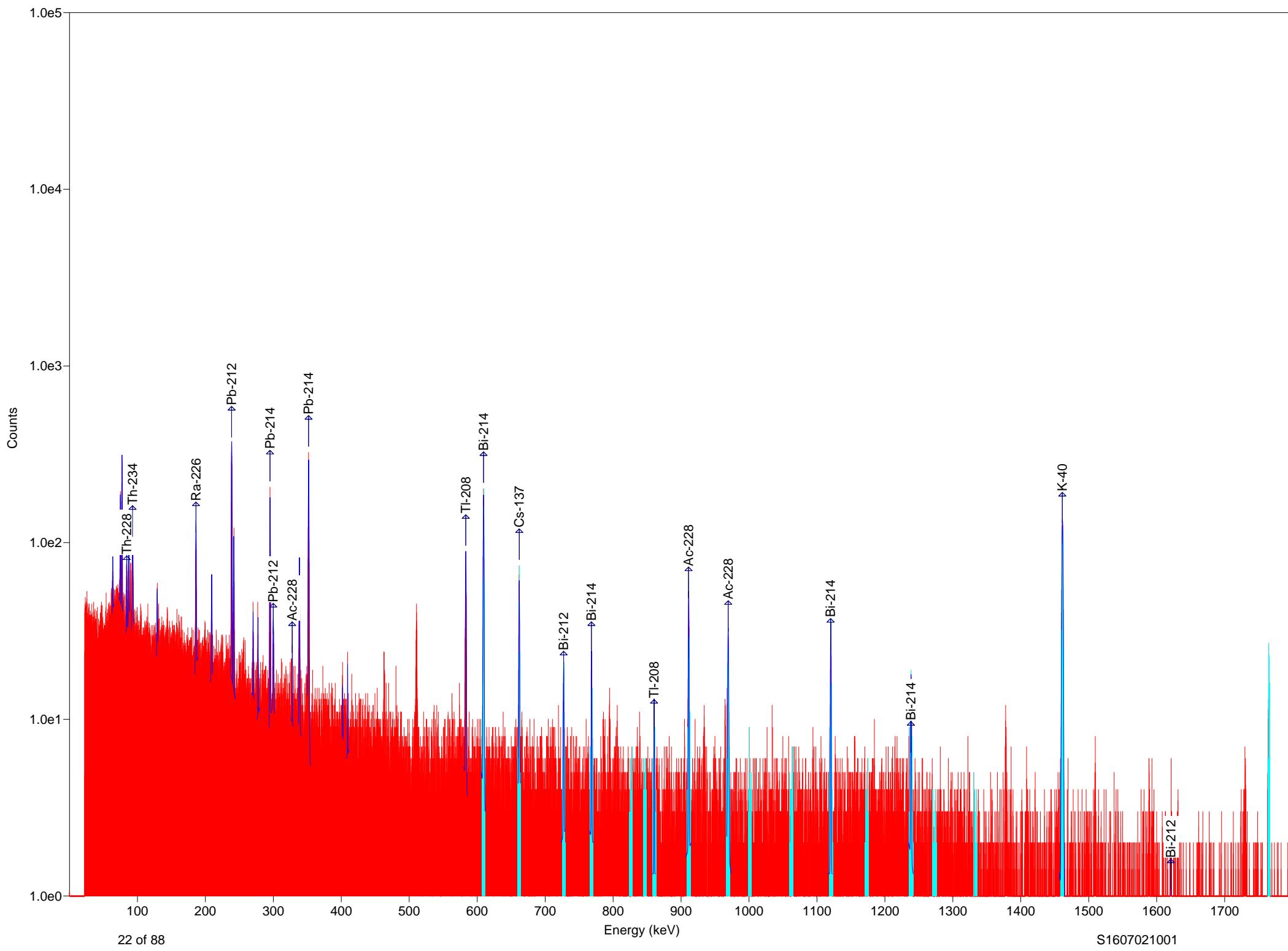
Detector #2 ACQ 05-Jul-2016 at 13:06:02 RT = 4521.8 LT = 4500.0
 Rad Chem 2
 LCS-187

ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY	(keV)
1	606.93 611.75 0.0051 0.0001	10540	9984	107	609.23	1.32	1.95	Bi-214	609.31
2	659.29 664.11 0.0000 0.0000	392	-18	33	663.45	0.22	0.35	Cs-137	661.66
3	724.58 729.84 0.0013 0.0001	709	334	39	727.17	1.21	1.92	Bi-212	727.00
4	765.77 771.02 0.0048 0.0003	1315	840	48	768.31	1.33	2.24	Bi-214	768.36
5	823.38 828.64 0.2014 0.1162	331	52	30	824.04	1.55	1.69	Co-60	826.28
6	843.53 848.79 0.0000 0.0000	331	-19	33	844.96	0.38	0.57	Co-56	846.77
7	857.99 863.25 0.0004 0.0001	525	183	35	860.25	1.51	1.89	Tl-208	860.56
8	908.38 914.07 0.0012 0.0001	1421	1070	47	911.07	1.37	2.31	Ac-228	911.20
9	966.21 971.90 0.0013 0.0001	891	643	38	968.91	1.40	2.32	Ac-228	968.97
10	998.19 1003.88 0.0056 0.0014	432	135	34	1001.00	1.10	2.11	Pa-234M	1001.03
11	1059.08 1065.21 match!	303	3	33	1059.73	0.22	0.35	No close library	
12	1117.34 1123.47 0.0056 0.0001	2371	2120	55	1120.14	1.60	2.60	Bi-214	1120.29
13	1170.34 1176.47 0.0000 0.0000	244	-41	32	1175.79	0.27	0.81	Co-60	1173.24
14	1235.17 1241.30 0.0055 0.0003	990	753	40	1238.06	1.67	2.49	Bi-214	1238.11
15	1269.55 1276.12 match!	205	-17	30	1271.74	0.22	0.35	No close library	
16	1329.34 1335.91 0.0000 0.0000	198	7	28	1334.59	0.22	0.35	Co-60	1332.50
17	1457.88 1464.45 0.0038 0.0002	1036	778	43	1460.68	1.92	2.98	K-40	1461.00
18	1761.13 1768.13 0.0069 0.0002	1788	1650	47	1764.41	1.95	3.02	Bi-214	1764.49



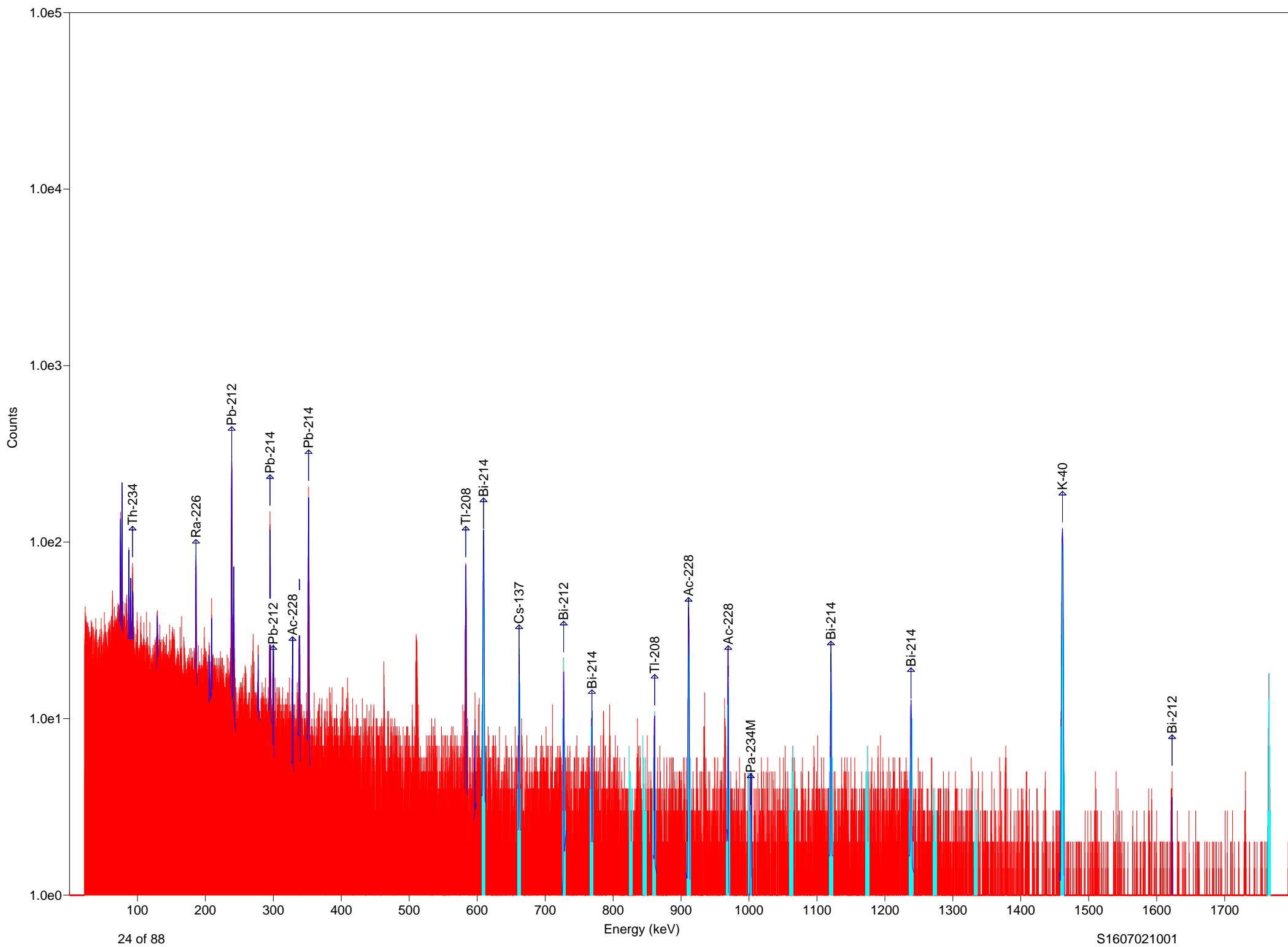
S1607021-001A.Rpt

Detector #2	ACQ	05-Jul-2016 at 14:32:18	RT = 4510.7	LT = 4500.0					
ROI#	RANGE(keV)	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY	(keV)
	µCi	+/-							
1	606.93 0.0004	611.75 0.0000	990	844	35	609.25	1.23	1.93	Bi-214 609.31
2	659.29 0.0001	664.11 0.0000	478	378	25	661.65	1.19	2.03	Cs-137 661.66
3	724.58 0.0007	729.84 0.0001	265	186	20	727.17	1.14	2.34	Bi-212 727.00
4	765.77 0.0003	771.02 0.0001	174	45	21	768.38	0.83	1.87	Bi-214 768.36
5	823.38 0.0000	828.64 0.0658	87	-9	17	825.03	0.48	0.72	Co-60 826.28
6	843.53 0.0000	848.79 0.0000	87	-13	17	844.41	0.27	0.48	Co-56 846.77
7	857.99 0.0002	863.25 0.0000	163	80	18	860.46	1.26	1.49	Tl-208 860.56
8	908.38 0.0006	914.07 0.0000	553	490	26	911.01	1.48	2.30	Ac-228 911.20
9	966.21 0.0006	971.90 0.0000	357	285	23	968.90	1.76	2.48	Ac-228 968.97
10	998.19 0.0008	1003.88 0.0006	79	20	15	999.60	3.36	3.56	Pa-234M 1001.03
11	1059.08 0.0000	1065.21 match!	87	-10	18	1063.24	0.22	0.35	No close library
12	1117.34 0.0004	1123.47 0.0001	243	141	23	1120.55	0.56	2.24	Bi-214 1120.29
13	1170.34 0.0000	1176.47 0.0000	98	-8	19	1171.22	1.10	1.23	Co-60 1173.24
14	1235.17 0.0004	1241.30 0.0002	172	56	22	1238.05	0.88	2.08	Bi-214 1238.11
15	1269.55 0.0000	1276.12 match!	51	4	14	1271.08	3.18	3.37	No close library
16	1329.34 0.0000	1335.91 0.0000	49	8	13	1331.53	0.22	0.35	Co-60 1332.50
17	1457.88 0.0065	1464.45 0.0002	1444	1351	41	1460.65	1.96	2.98	K-40 1461.00
18	1761.13 0.0006	1768.13 0.0001	163	146	14	1764.51	2.04	2.63	Bi-214 1764.49



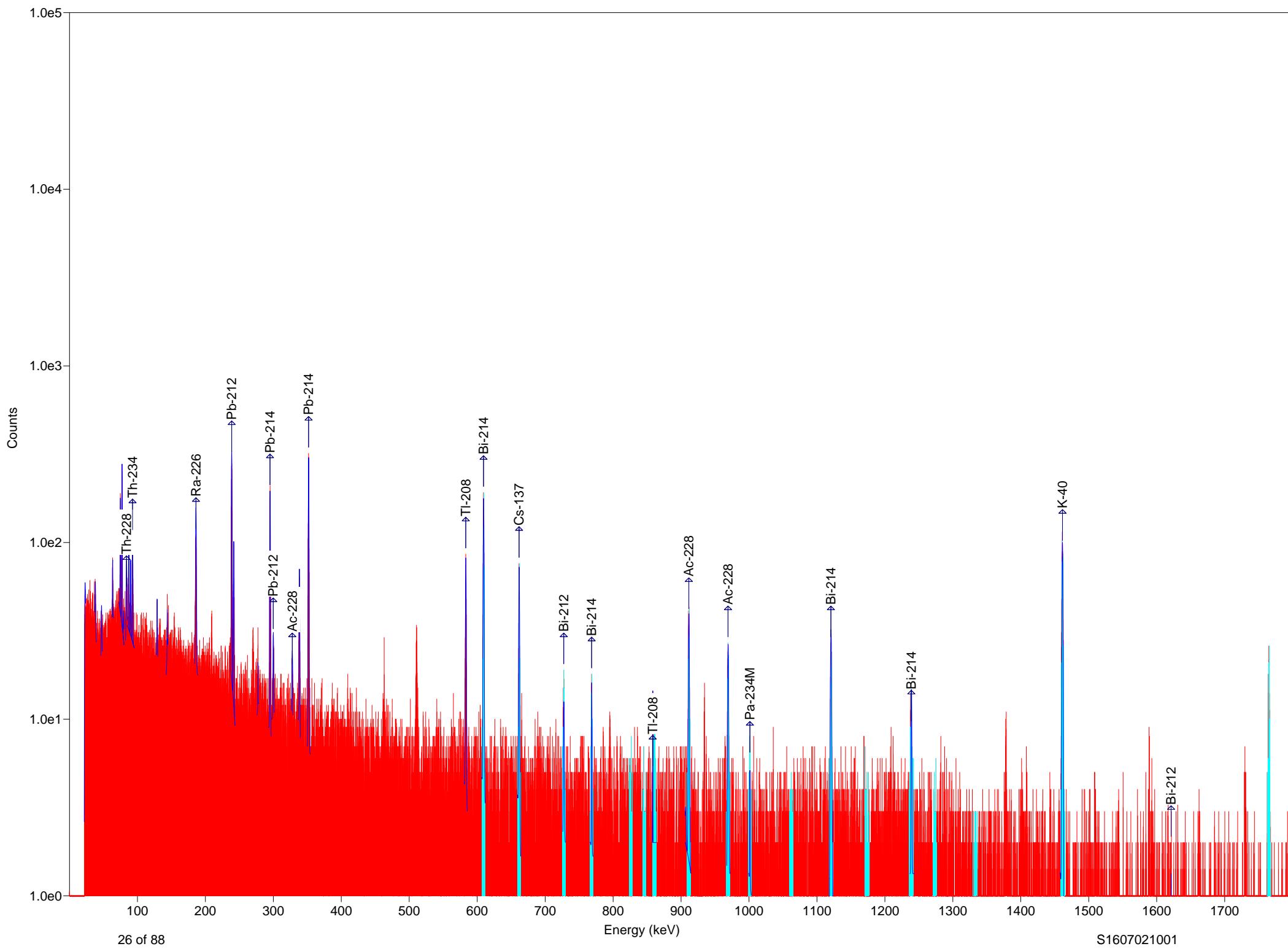
S1607021-002A.Rpt

Detector #2	ACQ	05-Jul-2016 at 15:49:30	RT = 4510.4	LT = 4500.0					
ROI#	RANGE(keV)	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY	(keV)
1	606.93 611.75 0.0006 0.0000	1217	1087	38	609.17	1.32	1.87	Bi-214	609.31
2	659.29 664.11 0.0001 0.0000	466	343	26	661.59	1.24	1.90	Cs-137	661.66
3	724.58 729.84 0.0004 0.0001	198	110	19	727.37	0.88	2.05	Bi-212	727.00
4	765.77 771.02 0.0004 0.0001	210	77	22	768.17	0.71	1.79	Bi-214	768.36
5	823.38 828.64 0.0000 0.0581	78	-1	15	824.70	3.07	3.20	Co-60	826.28
6	843.53 848.79 0.0000 0.0000	86	3	16	844.19	0.69	0.88	Co-56	846.77
7	857.99 863.25 0.0001 0.0000	131	27	18	860.25	0.51	1.45	Tl-208	860.56
8	908.38 914.07 0.0004 0.0000	412	308	25	910.98	1.23	2.11	Ac-228	911.20
9	966.21 971.90 0.0004 0.0000	273	192	21	968.81	1.56	2.34	Ac-228	968.97
10	998.19 1003.88 0.0013 0.0006	86	32	14	1000.13	0.28	0.49	Pa-234M	1001.03
11	1059.08 1065.21 match!	89	-22	20	1063.24	0.27	0.48	No close library	
12	1117.34 1123.47 0.0006 0.0001	299	217	23	1119.96	1.44	2.26	Bi-214	1120.29
13	1170.34 1176.47 0.0000 0.0000	79	11	16	1174.25	0.76	1.62	Co-60	1173.24
14	1235.17 1241.30 0.0001 0.0000	174	87	20	1238.41	1.16	2.49	Co-56	1238.28
15	1269.55 1276.12 match!	56	-11	16	1273.71	0.44	0.70	No close library	
16	1329.34 1335.91 0.0000 0.0000	43	12	11	1330.18	0.32	0.52	Co-60	1332.50
17	1457.88 1464.45 0.0056 0.0002	1228	1166	37	1460.67	1.88	2.83	K-40	1461.00
18	1761.13 1768.13 0.0009 0.0001	223	212	16	1764.30	1.57	2.65	Bi-214	1764.49



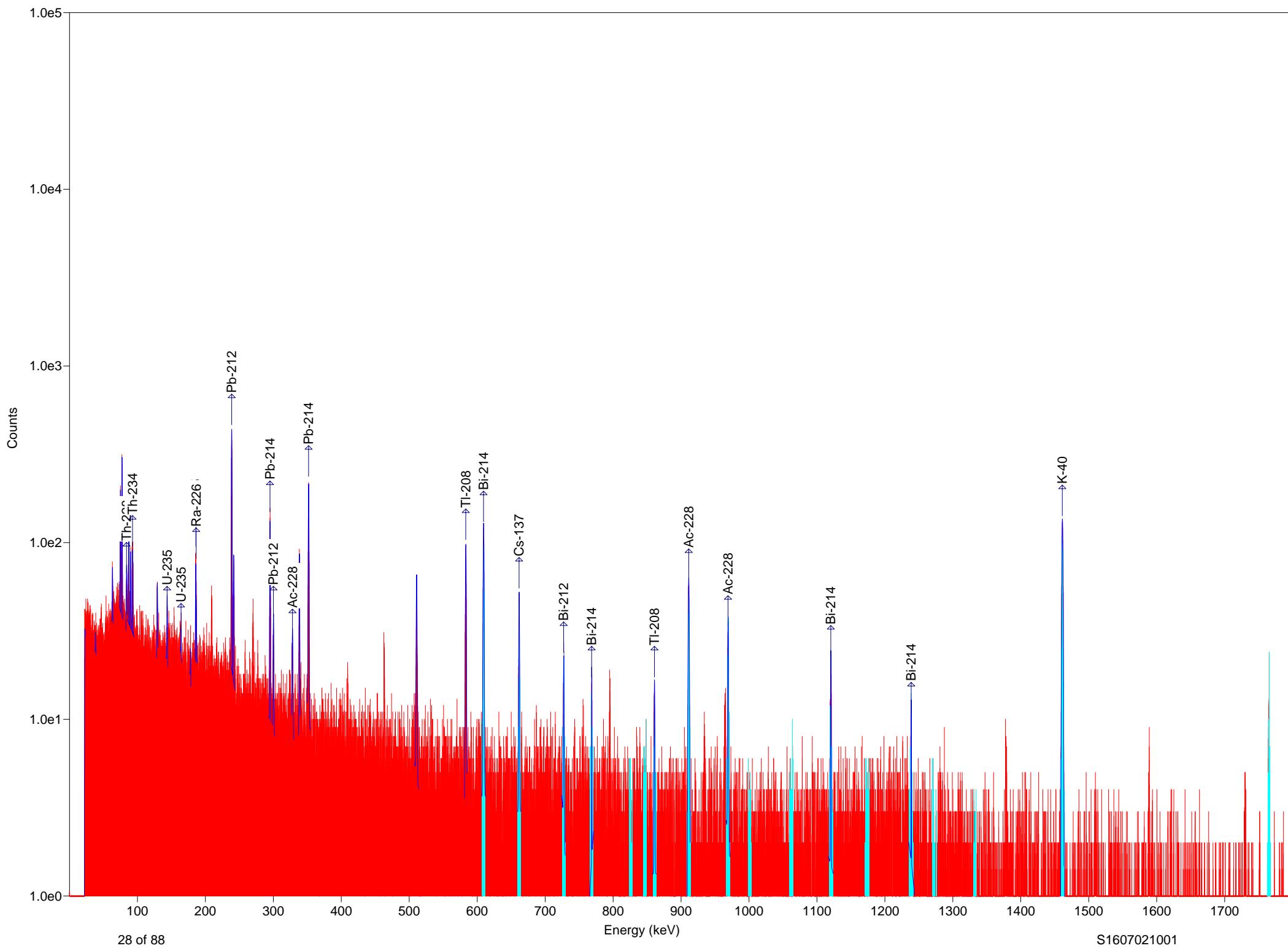
S1607021-003A.Rpt

Detector #2	ACQ	05-Jul-2016 at 17:06:52	RT = 4509.6	LT = 4500.0					
ROI#	RANGE(keV)	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY	(keV)
1	606.93 611.75 0.0003 0.0000	786	625	32	609.20	1.39	1.97	Bi-214	609.31
2	659.29 664.11 0.0000 0.0000	189	120	17	661.49	0.86	1.71	Cs-137	661.66
3	724.58 729.84 0.0004 0.0001	174	116	17	727.01	0.73	1.72	Bi-212	727.00
4	765.77 771.02 0.0003 0.0001	123	44	17	768.61	0.77	2.10	Bi-214	768.36
5	823.38 828.64 0.0000 0.0504	60	-3	13	824.70	2.63	2.76	Co-60	826.28
6	843.53 848.79 0.0000 0.0000	70	-22	16	847.26	0.22	0.35	Co-56	846.77
7	857.99 863.25 0.0001 0.0000	105	47	15	860.96	0.61	1.87	Tl-208	860.56
8	908.38 914.07 0.0003 0.0000	332	237	23	911.01	1.36	2.27	Ac-228	911.20
9	966.21 971.90 0.0003 0.0000	179	138	16	968.50	1.61	2.25	Ac-228	968.97
10	998.19 1003.88 0.0002 0.0006	72	4	15	999.03	0.32	0.52	Pa-234M	1001.03
11	1059.08 1065.21 match!	77	-5	17	1064.12	0.22	0.35	No close library	
12	1117.34 1123.47 0.0004 0.0001	224	147	21	1120.17	1.18	2.34	Bi-214	1120.29
13	1170.34 1176.47 0.0000 0.0000	81	-1	17	1174.06	0.22	0.35	Co-60	1173.24
14	1235.17 1241.30 0.0006 0.0001	135	77	17	1238.02	1.36	1.60	Bi-214	1238.11
15	1269.55 1276.12 match!	54	2	14	1270.87	0.33	0.61	No close library	
16	1329.34 1335.91 0.0000 0.0000	40	4	12	1331.97	0.22	0.35	Co-60	1332.50
17	1457.88 1464.45 0.0049 0.0002	1091	1019	36	1460.66	1.90	2.73	K-40	1461.00
18	1761.13 1768.13 0.0005 0.0001	131	109	14	1764.10	0.57	2.17	Bi-214	1764.49



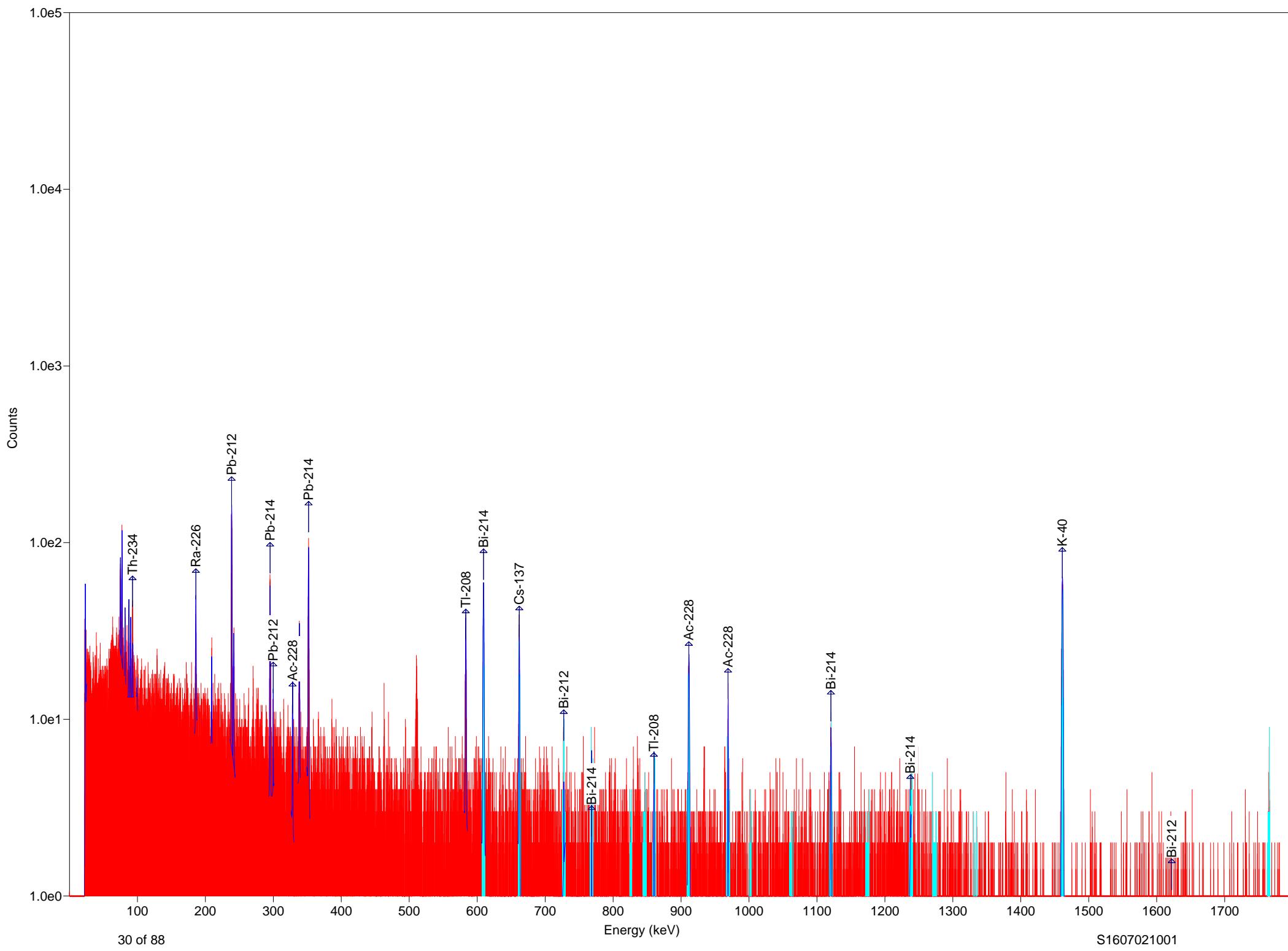
S1607021-004A.Rpt

Detector #2	ACQ	05-Jul-2016 at 18:24:17	RT = 4509.8	LT = 4500.0					
Rad	Chem	2							
S1607021-004A									
ROI#	RANGE(keV)	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY	(keV)
	μCi	+/-							
1	606.93 611.75 0.0005 0.0000	1173	1043	37	609.21	1.40	2.00	Bi-214	609.31
2	659.29 664.11 0.0001 0.0000	504	404	26	661.45	1.19	1.97	Cs-137	661.66
3	724.58 729.84 0.0003 0.0001	160	77	18	727.23	0.89	1.61	Bi-212	727.00
4	765.77 771.02 0.0004 0.0001	153	78	17	767.93	0.77	1.44	Bi-214	768.36
5	823.38 828.64 0.0000 0.0658	85	-11	17	826.45	0.22	0.35	Co-60	826.28
6	843.53 848.79 0.0000 0.0000	73	-6	15	844.85	0.22	0.35	Co-56	846.77
7	857.99 863.25 0.0001 0.0000	129	50	17	859.94	1.58	2.31	Tl-208	860.56
8	908.38 914.07 0.0003 0.0000	349	254	24	911.19	1.51	2.32	Ac-228	911.20
9	966.21 971.90 0.0004 0.0000	224	170	18	968.91	1.58	2.46	Ac-228	968.97
10	998.19 1003.88 0.0001 0.0007	79	2	16	1000.80	0.59	0.76	Pa-234M	1001.03
11	1059.08 1065.21 match!	70	-7	17	1059.73	2.41	2.54	No close library	
12	1117.34 1123.47 0.0005 0.0001	261	188	21	1120.15	1.73	2.12	Bi-214	1120.29
13	1170.34 1176.47 0.0000 0.0000	63	-48	19	1174.94	0.22	0.35	Co-60	1173.24
14	1235.17 1241.30 0.0004 0.0001	157	60	20	1237.88	0.58	1.76	Bi-214	1238.11
15	1269.55 1276.12 match!	57	0	15	1274.59	0.22	0.35	No close library	
16	1329.34 1335.91 0.0000 0.0000	38	-3	12	1331.97	1.31	1.45	Co-60	1332.50
17	1457.88 1464.45 0.0041 0.0002	920	853	33	1460.66	1.54	2.85	K-40	1461.00
18	1761.13 1768.13 0.0008 0.0001	217	200	16	1764.35	1.65	2.54	Bi-214	1764.49



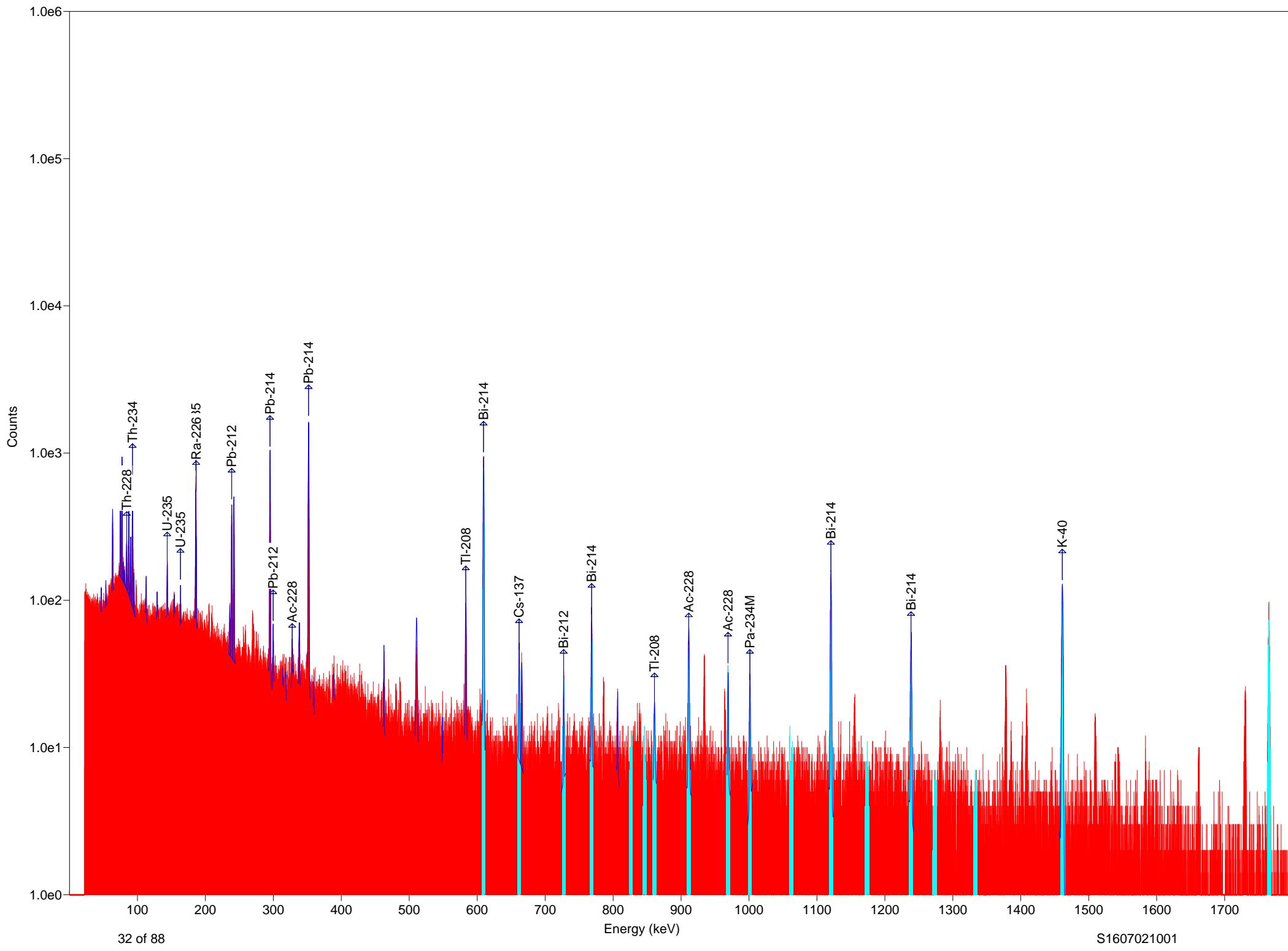
S1607021-005A.Rpt

Detector #2	ACQ	05-Jul-2016 at 20:10:51	RT = 4527.4	LT = 4500.0					
ROI#	RANGE(keV)	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY	(keV)
	µCi	+/-							
1	606.93 611.75 0.0004 0.0000	860	722	33	609.25	1.37	1.99	Bi-214	609.31
2	659.29 664.11 0.0001 0.0000	382	286	23	661.49	1.12	2.12	Cs-137	661.66
3	724.58 729.84 0.0004 0.0001	232	103	22	727.28	1.01	1.70	Bi-212	727.00
4	765.77 771.02 0.0005 0.0001	168	80	18	768.62	0.35	1.67	Bi-214	768.36
5	823.38 828.64 0.0000 0.0620	73	-15	16	824.26	1.31	1.56	Co-60	826.28
6	843.53 848.79 0.0000 0.0000	94	6	16	844.55	0.54	0.80	Co-56	846.77
7	857.99 863.25 0.0001 0.0000	137	58	17	860.37	0.98	1.73	Tl-208	860.56
8	908.38 914.07 0.0005 0.0000	467	399	25	911.04	1.64	2.10	Ac-228	911.20
9	966.21 971.90 0.0005 0.0001	320	216	24	968.96	1.22	2.47	Ac-228	968.97
10	998.19 1003.88 0.0000 0.0007	73	-4	16	998.84	3.94	4.07	Pa-234M	1001.03
11	1059.08 1065.21 match!	89	7	17	1063.70	0.26	0.46	No close library	
12	1117.34 1123.47 0.0004 0.0001	224	151	20	1120.70	0.50	2.83	Bi-214	1120.29
13	1170.34 1176.47 0.0000 0.0000	92	-19	20	1171.00	1.37	1.58	Co-60	1173.24
14	1235.17 1241.30 0.0005 0.0001	128	70	17	1237.77	0.38	1.63	Bi-214	1238.11
15	1269.55 1276.12 match!	60	-12	17	1270.65	0.22	0.35	No close library	
16	1329.34 1335.91 0.0000 0.0000	49	-3	14	1330.21	3.72	3.99	Co-60	1332.50
17	1457.88 1464.45 0.0055 0.0002	1221	1138	38	1460.62	1.89	2.75	K-40	1461.00
18	1761.13 1768.13 0.0006 0.0001	143	132	13	1764.54	0.86	2.17	Bi-214	1764.49



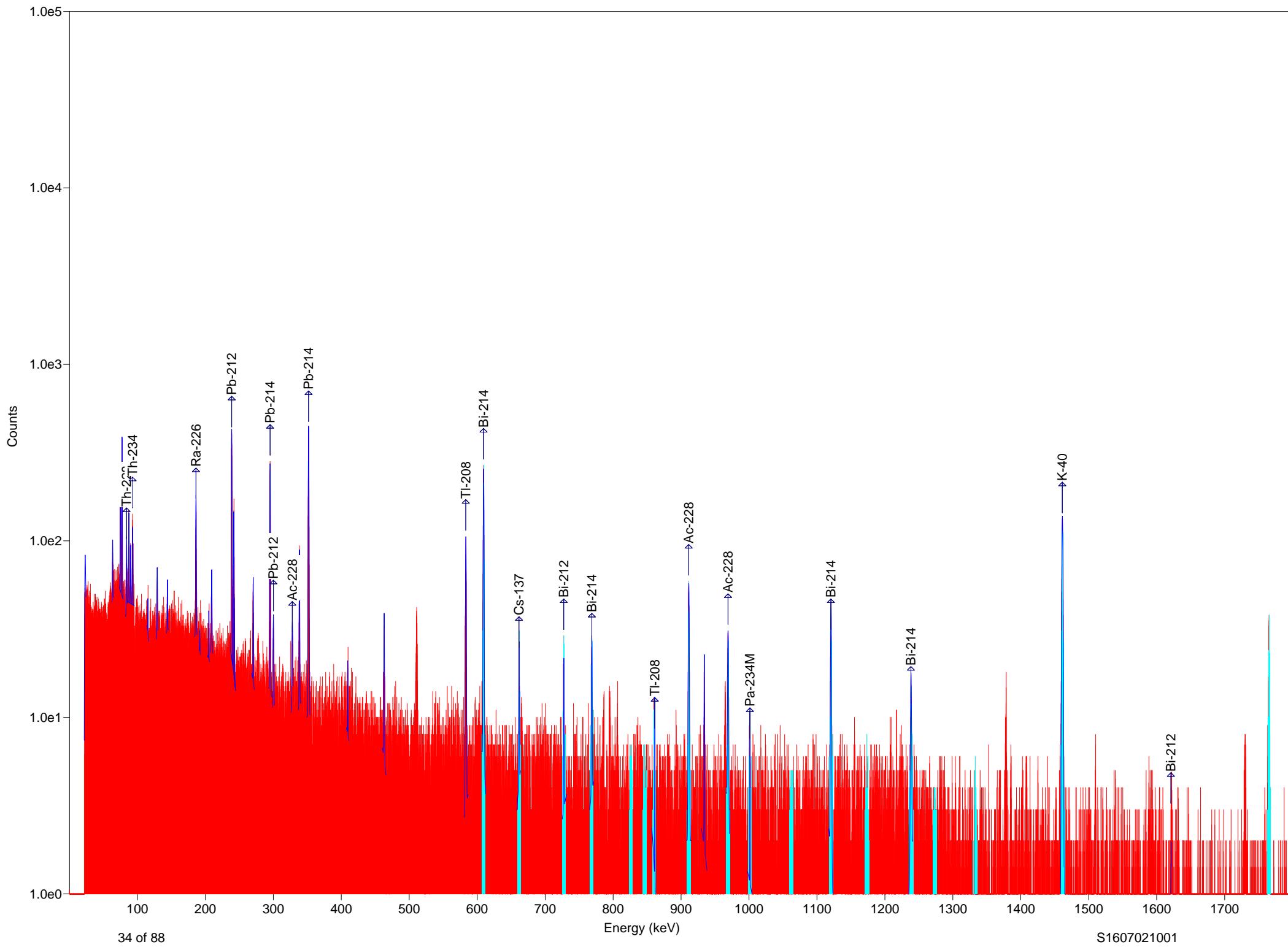
S1607021-006A.Rpt

Detector #2	ACQ	05-Jul-2016 at 23:37:39	RT = 4535.8	LT = 4500.0
Rad	Chem	2		
S1607021-006A				
ROI#	RANGE(keV)	GROSS	NET	+/-
	μ Ci +/-			
1	606.93 611.75 0.0002 0.0000	410	341	23
2	659.29 664.11 0.0001 0.0000	238	203	17
3	724.58 729.84 0.0001 0.0001	91	28	15
4	765.77 771.02 0.0003 0.0001	77	44	12
5	823.38 828.64 0.0581 0.0349	36	15	9
6	843.53 848.79 0.0000 0.0000	41	-17	12
7	857.99 863.25 0.0000 0.0000	58	12	12
8	908.38 914.07 0.0001 0.0000	182	128	17
9	966.21 971.90 0.0001 0.0000	107	71	14
10	998.19 1003.88 0.0003 0.0004	33	6	10
11	1059.08 1065.21	39	-9	13
12	1117.34 1123.47 0.0001 0.0000	95	47	15
13	1170.34 1176.47 0.0000 0.0000	42	-2	12
14	1235.17 1241.30 0.0000 0.0000	71	23	14
15	1269.55 1276.12	39	-18	14
16	1329.34 1335.91 0.0000 0.0000	26	-5	11
17	1457.88 1464.45 0.0027 0.0001	577	551	25
18	1761.13 1768.13 0.0002 0.0000	55	49	8



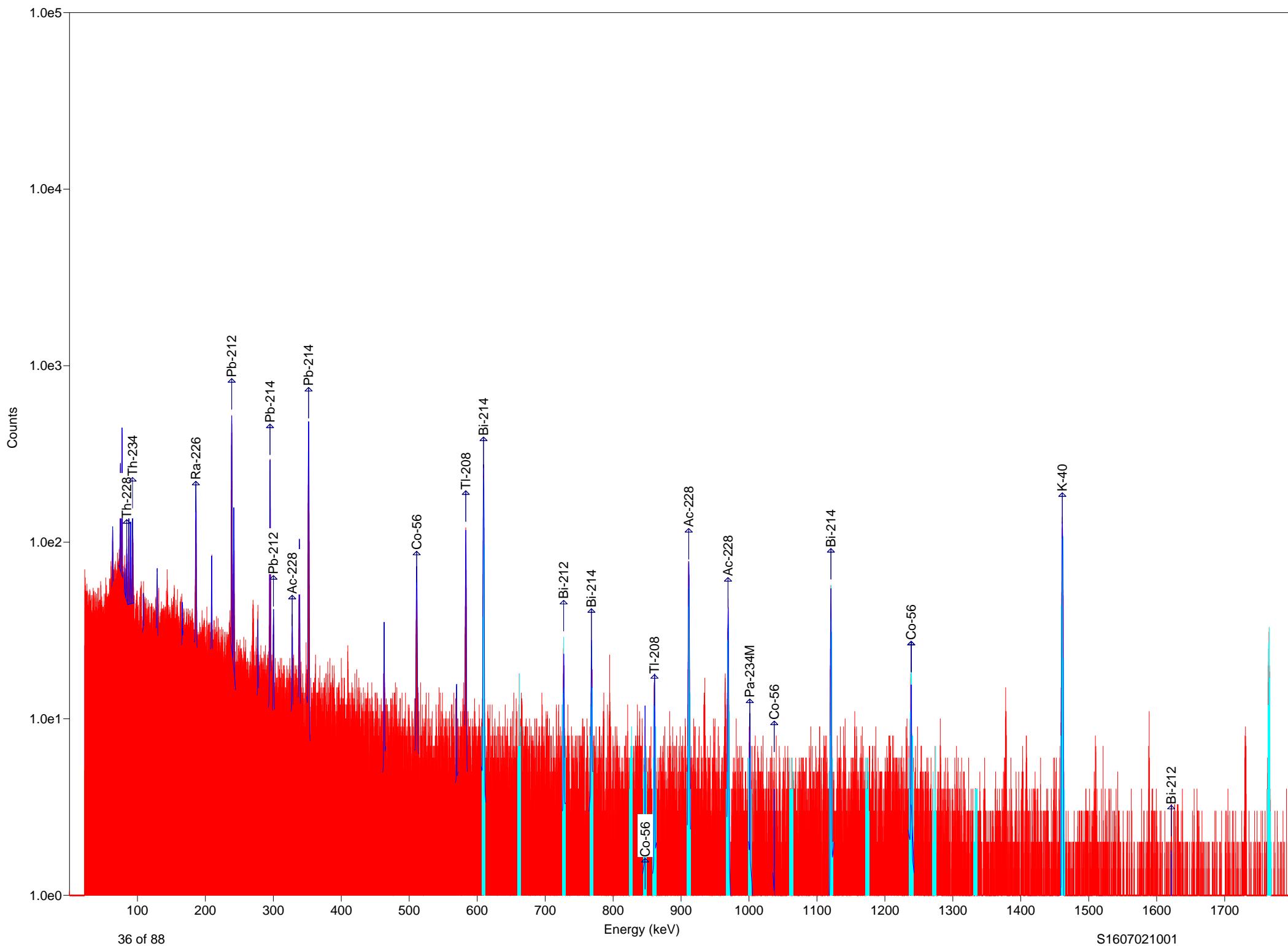
S1607021-007A.Rpt

Detector #2	ACQ	06-Jul-2016	at	8:11:32	RT =	4514.8	LT =	4500.0
Rad	Chem	2						
S1607021-007A								
ROI#	RANGE(keV)	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
	μCi	+/-						
1	606.93 611.75 0.0029 0.0000	5990	5702	80	609.22	1.25	1.95	Bi-214 609.31
2	659.29 664.11 0.0001 0.0000	509	287	30	661.50	1.20	2.00	Cs-137 661.66
3	724.58 729.84 0.0005 0.0001	331	143	27	727.16	0.88	1.94	Bi-212 727.00
4	765.77 771.02 0.0029 0.0002	732	499	35	768.33	1.16	2.20	Bi-214 768.36
5	823.38 828.64 0.1627 0.0852	192	42	22	826.67	0.24	0.38	Co-60 826.28
6	843.53 848.79 0.0000 0.0000	192	-29	25	845.94	0.22	0.35	Co-56 846.77
7	857.99 863.25 0.0002 0.0001	250	71	25	860.53	1.77	2.10	Tl-208 860.56
8	908.38 914.07 0.0004 0.0000	562	355	32	911.05	1.51	2.13	Ac-228 911.20
9	966.21 971.90 0.0003 0.0001	359	156	29	968.85	0.76	1.80	Ac-228 968.97
10	998.19 1003.88 0.0056 0.0011	320	135	27	1001.09	1.45	2.20	Pa-234M 1001.03
11	1059.08 1065.21 match!	181	17	25	1059.95	0.22	0.35	No close library
12	1117.34 1123.47 0.0029 0.0001	1347	1115	44	1120.25	1.46	2.57	Bi-214 1120.29
13	1170.34 1176.47 0.0000 0.0000	158	32	22	1173.80	0.30	0.53	Co-60 1173.24
14	1235.17 1241.30 0.0031 0.0002	580	420	32	1238.01	1.53	2.83	Bi-214 1238.11
15	1269.55 1276.12 match!	100	22	18	1272.40	0.27	1.02	No close library
16	1329.34 1335.91 0.0000 0.0000	119	31	19	1332.59	1.74	2.48	Co-60 1332.50
17	1457.88 1464.45 0.0049 0.0002	1181	1016	41	1460.63	1.99	2.84	K-40 1461.00
18	1761.13 1768.13 0.0039 0.0001	963	930	32	1764.26	2.14	3.35	Bi-214 1764.49



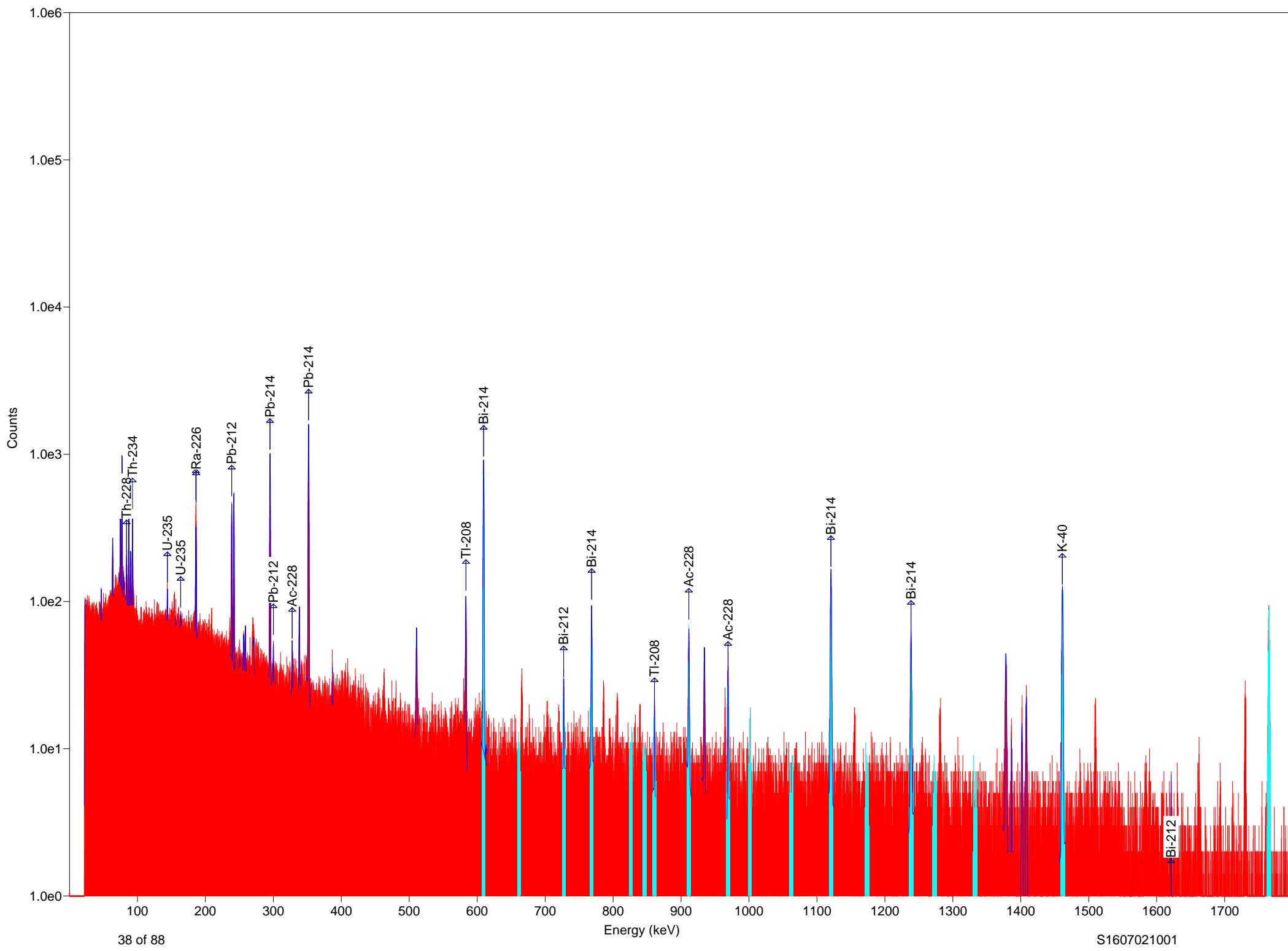
S1607021-008A.Rpt

Detector #2	ACQ	06-Jul-2016	at	9:27:58	RT =	4510.2	LT =	4500.0
Rad	Chem	2						
S1607021-008A								
ROI#	RANGE(keV)	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
	μCi	+/-						
1	606.93 611.75 0.0008 0.0000	1660	1514	43	609.20	1.21	1.92	Bi-214 609.31
2	659.29 664.11 0.0000 0.0000	237	103	21	661.58	0.91	1.47	Cs-137 661.66
3	724.58 729.84 0.0004 0.0001	221	100	21	727.07	0.75	1.94	Bi-212 727.00
4	765.77 771.02 0.0006 0.0001	267	109	24	768.52	0.98	1.84	Bi-214 768.36
5	823.38 828.64 0.1201 0.0542	89	31	14	824.91	2.22	3.02	Co-60 826.28
6	843.53 848.79 0.0000 0.0000	103	-10	18	844.85	0.22	0.35	Co-56 846.77
7	857.99 863.25 0.0002 0.0000	151	76	17	861.24	0.30	1.99	Tl-208 860.56
8	908.38 914.07 0.0004 0.0000	445	355	25	910.96	1.54	2.35	Ac-228 911.20
9	966.21 971.90 0.0004 0.0000	283	193	22	968.91	1.32	2.42	Ac-228 968.97
10	998.19 1003.88 0.0013 0.0007	109	32	17	1000.18	0.29	1.87	Pa-234M 1001.03
11	1059.08 1065.21 match!	88	-14	19	1059.73	2.30	2.50	No close library
12	1117.34 1123.47 0.0008 0.0001	393	301	25	1120.17	1.40	2.20	Bi-214 1120.29
13	1170.34 1176.47 0.0000 0.0000	80	12	16	1173.00	0.27	0.78	Co-60 1173.24
14	1235.17 1241.30 0.0007 0.0001	183	101	20	1237.97	1.69	3.88	Bi-214 1238.11
15	1269.55 1276.12 match!	70	18	15	1274.59	0.27	0.48	No close library
16	1329.34 1335.91 0.0000 0.0000	50	3	14	1331.09	1.75	1.88	Co-60 1332.50
17	1457.88 1464.45 0.0054 0.0002	1229	1120	39	1460.59	1.86	2.86	K-40 1461.00
18	1761.13 1768.13 0.0012 0.0001	293	276	18	1764.22	0.82	2.71	Bi-214 1764.49



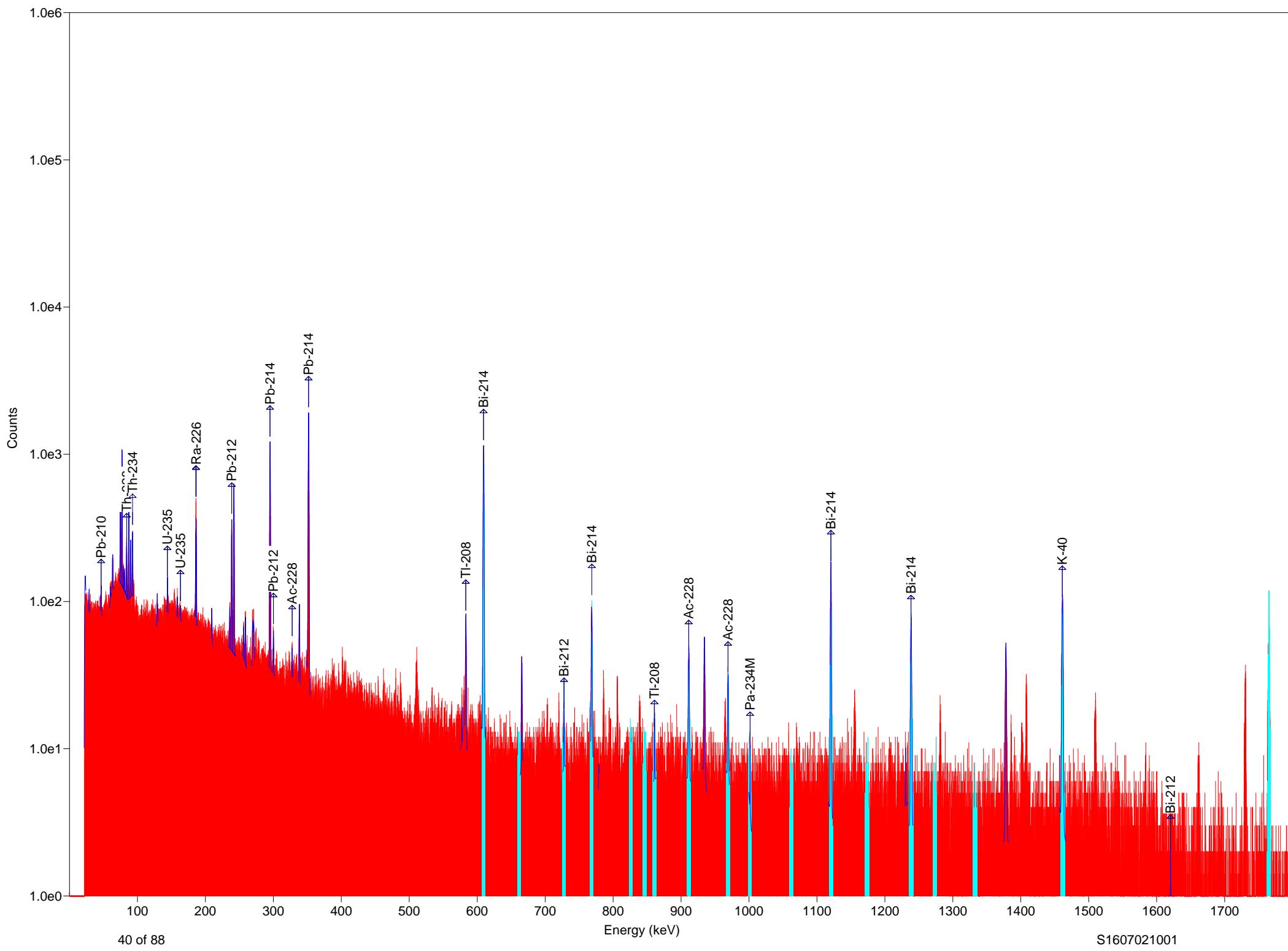
S1607021-009A.Rpt

Detector #2	ACQ	06-Jul-2016 at 10:45:58	RT = 4510.4	LT = 4500.0					
ROI#	RANGE(keV)	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY	(keV)
1	606.93 611.75 0.0008 0.0000	1767	1617	45	609.20	1.30	2.00	Bi-214	609.31
2	659.29 664.11 0.0000 0.0000	161	-8	21	661.72	0.25	0.41	Cs-137	661.66
3	724.58 729.84 0.0005 0.0001	254	125	23	727.03	1.15	2.23	Bi-212	727.00
4	765.77 771.02 0.0007 0.0001	272	122	24	768.23	1.07	1.79	Bi-214	768.36
5	823.38 828.64 0.1549 0.0620	115	40	16	827.11	0.22	0.35	Co-60	826.28
6	843.53 848.79 0.0000 0.0000	112	29	17	846.60	0.25	0.39	Co-56	846.77
7	857.99 863.25 0.0002 0.0000	175	96	18	860.26	0.89	2.77	Tl-208	860.56
8	908.38 914.07 0.0006 0.0000	610	515	29	911.05	1.43	2.22	Ac-228	911.20
9	966.21 971.90 0.0006 0.0001	362	267	24	968.85	1.38	2.64	Ac-228	968.97
10	998.19 1003.88 0.0003 0.0008	123	6	20	999.91	1.82	2.14	Pa-234M	1001.03
11	1059.08 1065.21 match!	94	-27	20	1062.36	0.88	1.01	No close library	
12	1117.34 1123.47 0.0008 0.0001	438	322	27	1120.14	1.72	2.43	Bi-214	1120.29
13	1170.34 1176.47 0.0000 0.0000	99	-3	19	1171.00	1.97	2.10	Co-60	1173.24
14	1235.17 1241.30 0.0008 0.0002	232	106	24	1237.98	1.26	2.47	Bi-214	1238.11
15	1269.55 1276.12 match!	69	12	15	1273.49	0.25	0.39	No close library	
16	1329.34 1335.91 0.0000 0.0000	64	2	16	1332.62	1.72	1.87	Co-60	1332.50
17	1457.88 1464.45 0.0052 0.0002	1178	1080	38	1460.58	1.56	2.92	K-40	1461.00
18	1761.13 1768.13 0.0012 0.0001	321	282	21	1764.30	2.13	3.08	Bi-214	1764.49



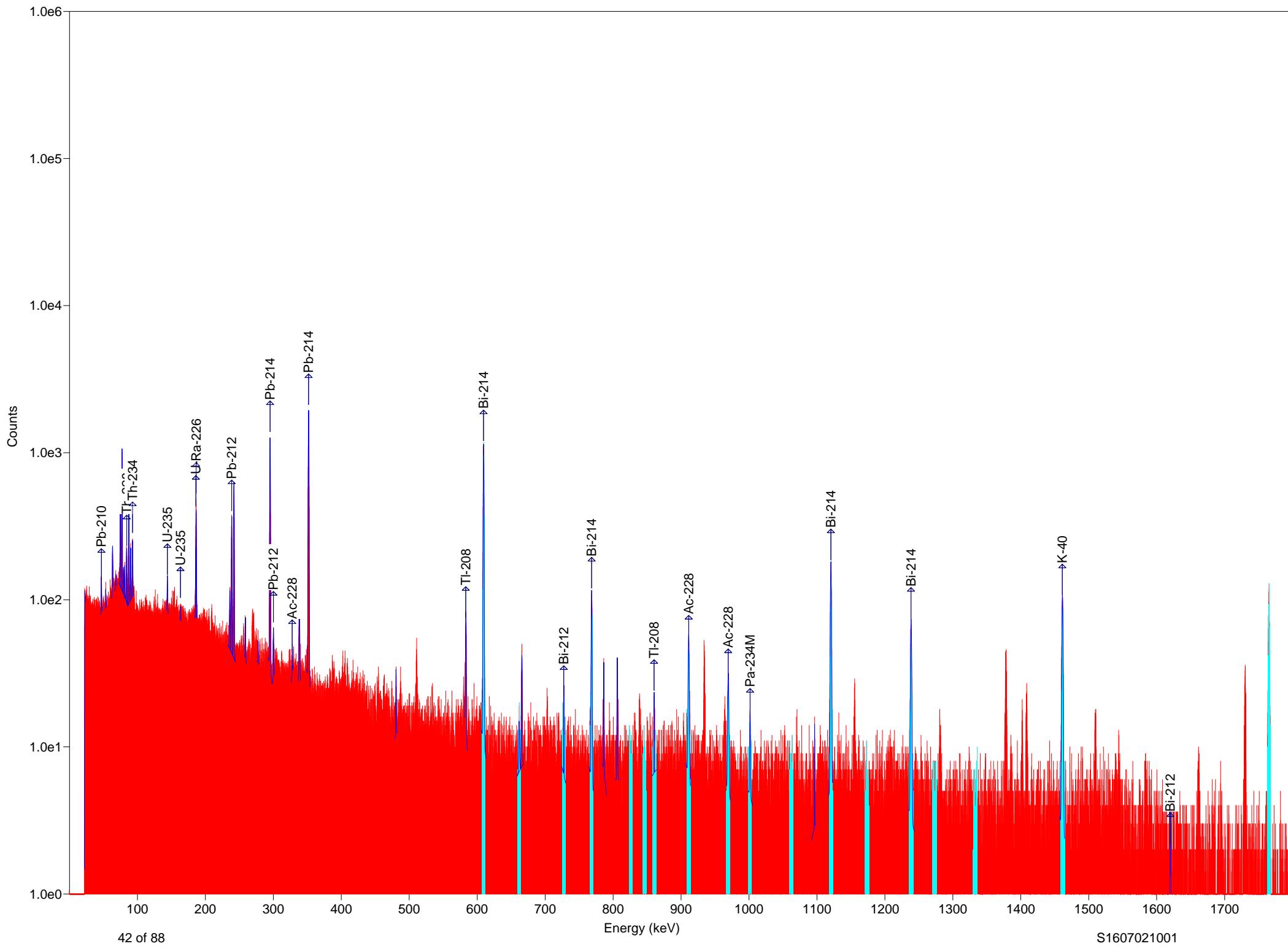
S1607021-010A.Rpt

Detector #2	ACQ	06-Jul-2016 at 12:02:33	RT = 4514.6	LT = 4500.0					
Rad	Chem	2							
S1607021-010A									
ROI#	RANGE(keV)	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY	(keV)
	μCi	+/-							
1	606.93 611.75 0.0028 0.0000	5881	5517	80	609.23	1.26	1.98	Bi-214	609.31
2	659.29 664.11 0.0000 0.0000	189	-14	23	661.04	0.22	0.35	Cs-137	661.66
3	724.58 729.84 0.0005 0.0001	357	140	28	726.99	0.86	1.69	Bi-212	727.00
4	765.77 771.02 0.0026 0.0002	760	460	37	768.25	1.22	2.06	Bi-214	768.36
5	823.38 828.64 0.1975 0.0891	214	51	23	827.15	0.28	0.81	Co-60	826.28
6	843.53 848.79 0.0000 0.0000	191	8	24	845.47	2.95	3.62	Co-56	846.77
7	857.99 863.25 0.0002 0.0001	253	70	25	860.64	0.77	1.40	Tl-208	860.56
8	908.38 914.07 0.0004 0.0000	586	370	33	911.09	1.41	1.94	Ac-228	911.20
9	966.21 971.90 0.0004 0.0001	368	183	28	968.76	1.21	2.09	Ac-228	968.97
10	998.19 1003.88 0.0011 0.0011	234	27	27	1001.50	0.50	1.42	Pa-234M	1001.03
11	1059.08 1065.21 match!	155	20	23	1059.84	4.82	4.95	No close library	
12	1117.34 1123.47 0.0031 0.0001	1403	1161	45	1120.18	1.68	2.28	Bi-214	1120.29
13	1170.34 1176.47 0.0000 0.0000	147	26	22	1171.22	0.26	0.41	Co-60	1173.24
14	1235.17 1241.30 0.0030 0.0002	581	402	32	1237.95	1.66	2.27	Bi-214	1238.11
15	1269.55 1276.12 match!	141	-4	24	1272.03	0.49	0.72	No close library	
16	1329.34 1335.91 0.0000 0.0000	118	-6	22	1330.04	0.31	0.52	Co-60	1332.50
17	1457.88 1464.45 0.0049 0.0002	1164	1009	40	1460.71	1.88	2.85	K-40	1461.00
18	1761.13 1768.13 0.0038 0.0002	998	904	36	1764.26	2.33	3.05	Bi-214	1764.49



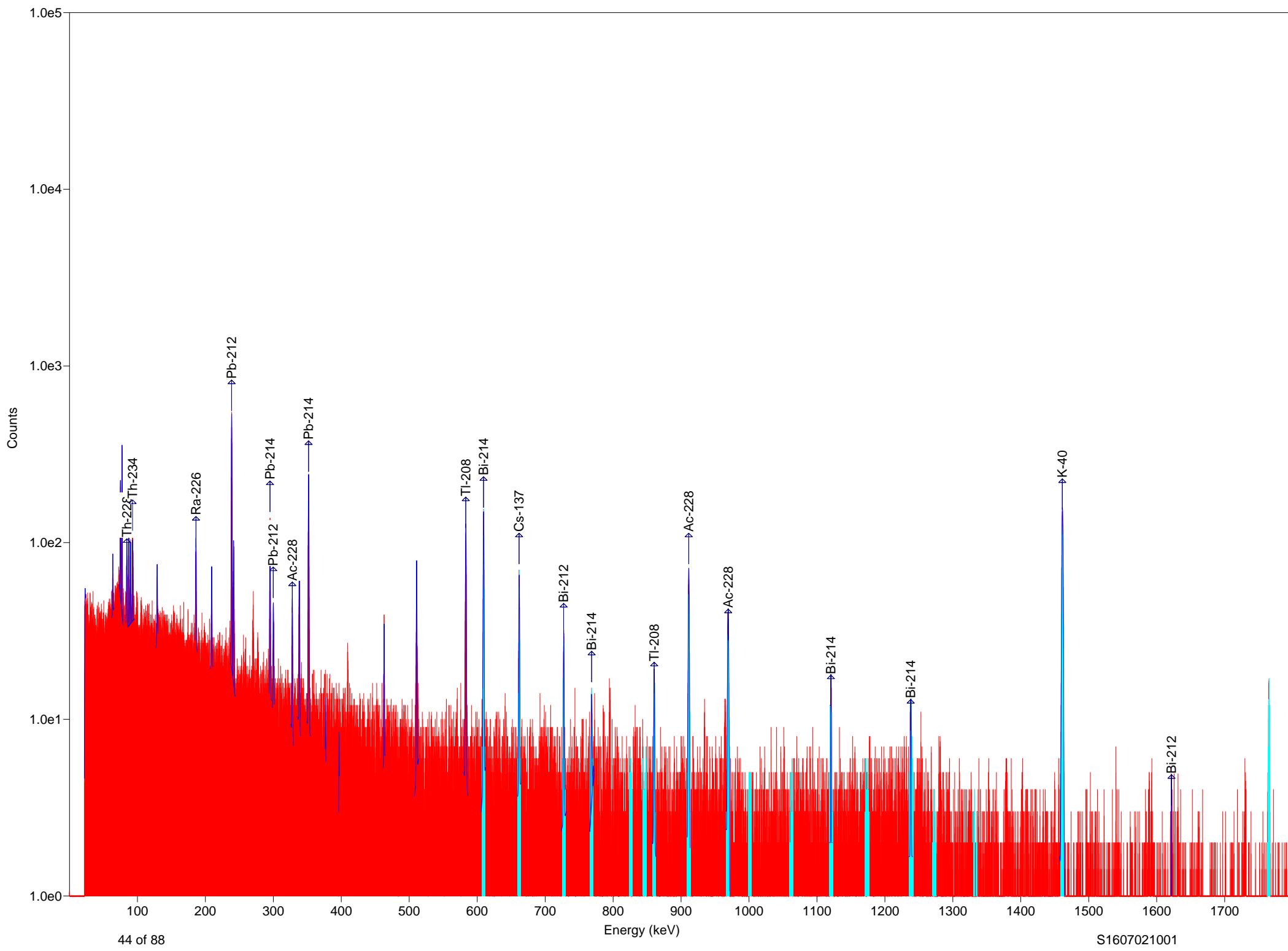
S1607021-011A.Rpt

Detector #2	ACQ	06-Jul-2016 at 14:16:13	RT = 4515.7	LT = 4500.0					
Rad	Chem	2							
S1607021-011A									
ROI#	RANGE(keV)	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY	(keV)
	μCi	+/-							
1	606.93 611.75 0.0034 0.0000	7226	6800	89	609.23	1.28	1.92	Bi-214	609.31
2	659.29 664.11 0.0000 0.0000	215	-15	25	659.95	1.13	1.65	Cs-137	661.66
3	724.58 729.84 0.0003 0.0001	309	80	28	727.20	0.92	1.81	Bi-212	727.00
4	765.77 771.02 0.0029 0.0002	818	501	38	768.25	1.22	2.05	Bi-214	768.36
5	823.38 828.64 0.0620 0.1007	241	16	26	825.35	0.22	0.35	Co-60	826.28
6	843.53 848.79 0.0000 0.0000	209	1	25	845.29	0.22	0.35	Co-56	846.77
7	857.99 863.25 0.0001 0.0001	243	51	25	860.03	0.62	1.28	Tl-208	860.56
8	908.38 914.07 0.0003 0.0000	476	282	30	911.09	1.43	2.31	Ac-228	911.20
9	966.21 971.90 0.0003 0.0001	369	153	30	968.90	1.15	1.80	Ac-228	968.97
10	998.19 1003.88 0.0013 0.0010	201	30	25	1001.56	1.25	1.42	Pa-234M	1001.03
11	1059.08 1065.21 match!	160	29	23	1061.71	0.57	0.84	No close library	
12	1117.34 1123.47 0.0035 0.0001	1532	1310	46	1120.18	1.54	2.37	Bi-214	1120.29
13	1170.34 1176.47 0.0000 0.0000	158	37	22	1174.50	0.22	0.35	Co-60	1173.24
14	1235.17 1241.30 0.0041 0.0002	707	562	33	1238.01	1.68	2.55	Bi-214	1238.11
15	1269.55 1276.12 match!	162	33	23	1275.03	0.23	0.38	No close library	
16	1329.34 1335.91 0.0000 0.0000	117	14	21	1331.13	4.04	4.49	Co-60	1332.50
17	1457.88 1464.45 0.0041 0.0002	1055	859	40	1460.64	1.73	2.78	K-40	1461.00
18	1761.13 1768.13 0.0045 0.0002	1139	1084	36	1764.45	1.95	3.27	Bi-214	1764.49



S1607021-011AD.Rpt

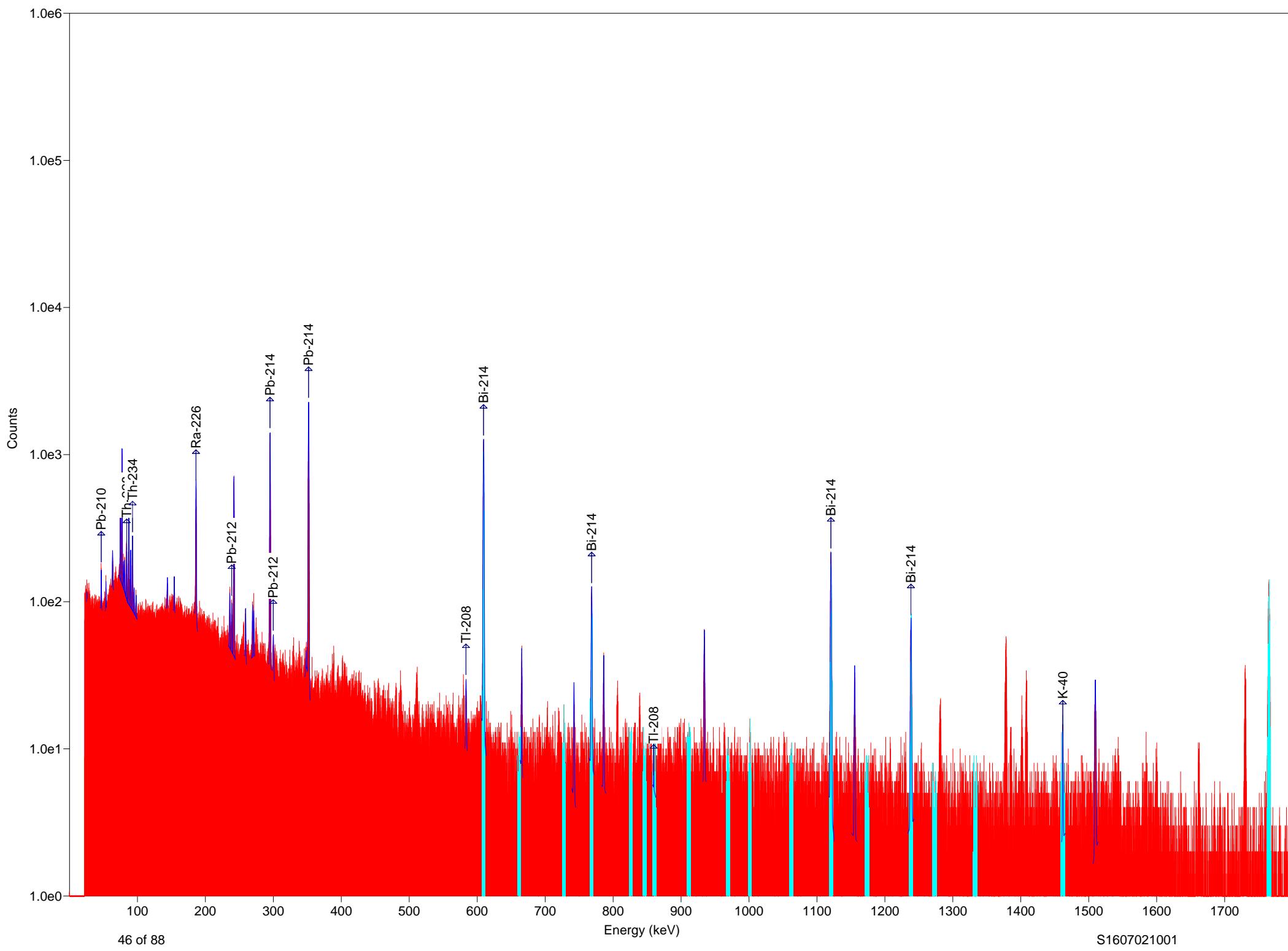
Detector #2	ACQ	06-Jul-2016 at 15:34:00	RT = 4516.4	LT = 4500.0					
Rad	Chem	2							
S1607021-011AD									
ROI#	RANGE(keV)	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY	(keV)
	μCi	+/-							
1	606.93 611.75 0.0034 0.0000	7137	6742	88	609.21	1.23	1.90	Bi-214	609.31
2	659.29 664.11 0.0000 0.0000	241	38	24	661.77	0.41	0.63	Cs-137	661.66
3	724.58 729.84 0.0003 0.0001	320	78	29	727.84	0.32	1.70	Bi-212	727.00
4	765.77 771.02 0.0035 0.0002	877	606	38	768.28	1.20	1.89	Bi-214	768.36
5	823.38 828.64 0.0039 0.1007	222	1	26	826.78	0.40	0.55	Co-60	826.28
6	843.53 848.79 0.0000 0.0000	187	45	22	845.51	0.23	0.38	Co-56	846.77
7	857.99 863.25 0.0002 0.0001	280	76	26	859.98	0.27	1.24	Tl-208	860.56
8	908.38 914.07 0.0003 0.0000	527	275	34	911.10	1.60	2.33	Ac-228	911.20
9	966.21 971.90 0.0003 0.0001	332	129	28	968.81	1.58	2.04	Ac-228	968.97
10	998.19 1003.88 0.0033 0.0010	229	80	24	1000.65	1.17	3.76	Pa-234M	1001.03
11	1059.08 1065.21 match!	191	27	25	1063.26	0.34	0.62	No close library	
12	1117.34 1123.47 0.0035 0.0001	1538	1316	46	1120.21	1.74	2.73	Bi-214	1120.29
13	1170.34 1176.47 0.0000 0.0000	152	-12	24	1172.53	0.24	0.39	Co-60	1173.24
14	1235.17 1241.30 0.0040 0.0002	673	542	32	1238.03	1.76	2.65	Bi-214	1238.11
15	1269.55 1276.12 match!	159	4	25	1270.21	4.87	5.08	No close library	
16	1329.34 1335.91 0.0000 0.0000	123	25	20	1335.25	0.24	0.38	Co-60	1332.50
17	1457.88 1464.45 0.0043 0.0002	1022	888	38	1460.70	1.85	2.94	K-40	1461.00
18	1761.13 1768.13 0.0046 0.0001	1134	1090	35	1764.38	2.06	3.21	Bi-214	1764.49



ROCKYFLATS.Rpt

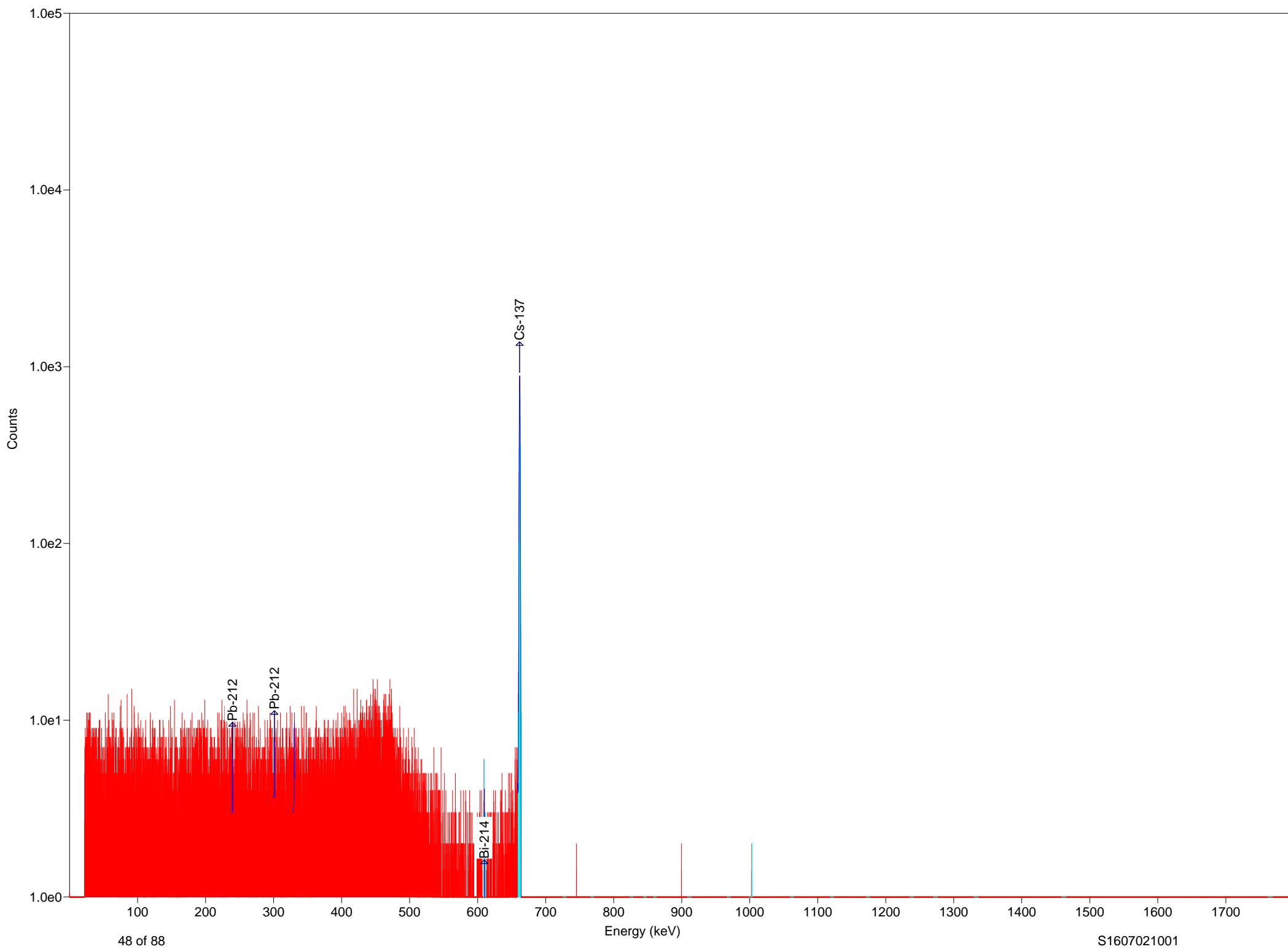
Detector #2 ACQ 06-Jul-2016 at 16:54:30 RT = 4508.1 LT = 4500.0
 Rad Chem 2
 ROCKYFLATS

ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
1	606.93 611.75 0.0001 0.0000	272	195	20	609.18	1.49	2.07	Bi-214 609.31
2	659.29 664.11 0.0000 0.0000	167	125	15	661.76	0.83	1.96	Cs-137 661.66
3	724.58 729.84 0.0002 0.0000	87	54	12	727.23	0.90	1.25	Bi-212 727.00
4	765.77 771.02 0.0001 0.0001	74	24	13	767.72	0.61	0.81	Bi-214 768.36
5	823.38 828.64 0.0000 0.0387	38	0	10	825.79	0.22	0.35	Co-60 826.28
6	843.53 848.79 0.0000 0.0000	40	-2	11	846.16	0.22	0.35	Co-56 846.77
7	857.99 863.25 0.0001 0.0000	68	39	11	860.11	0.79	1.17	Tl-208 860.56
8	908.38 914.07 0.0002 0.0000	197	143	18	911.21	1.00	1.88	Ac-228 911.20
9	966.21 971.90 0.0002 0.0000	118	73	15	968.52	0.55	2.10	Ac-228 968.97
10	998.19 1003.88	28	-17	11	Could not properly fit the peak.			
11	1059.08 1065.21 match!	48	-5	14	1060.17	0.22	0.35	No close library
12	1117.34 1123.47 0.0002 0.0000	86	71	11	1120.08	1.09	1.86	Bi-214 1120.29
13	1170.34 1176.47 0.0000 0.0000	28	-1	10	1174.72	0.22	0.35	Co-60 1173.24
14	1235.17 1241.30 0.0000 0.0000	33	4	10	1238.23	0.66	0.79	Co-56 1238.28
15	1269.55 1276.12 match!	24	3	9	1270.65	4.60	4.73	No close library
16	1329.34 1335.91 0.0000 0.0000	22	-4	10	1330.65	0.22	0.35	Co-60 1332.50
17	1457.88 1464.45 0.0015 0.0001	347	311	21	1460.61	1.53	2.50	K-40 1461.00
18	1761.13 1768.13 0.0001 0.0000	32	32	5	1763.65	2.34	3.30	Bi-214 1764.49



UTS-4.Rpt

Detector #2	ACQ	06-Jul-2016 at 23:07:24	RT = 4549.3	LT = 4500.0					
ROI#	RANGE(keV)	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY	(keV)
	µCi +/-								
1	606.93 611.75 0.0039 0.0000	7984	7608	93	609.20	1.29	1.94	Bi-214	609.31
2	659.29 664.11 0.0000 0.0000	222	-54	26	660.83	0.22	0.35	Cs-137	661.66
3	724.58 729.84 0.0001 0.0001	227	27	25	727.53	0.36	0.54	Bi-212	727.00
4	765.77 771.02 0.0035 0.0002	978	611	42	768.31	1.40	2.01	Bi-214	768.36
5	823.38 828.64 0.1239 0.0891	190	32	23	826.78	0.39	0.57	Co-60	826.28
6	843.53 848.79 0.0000 0.0000	197	9	24	847.86	0.50	1.37	Co-56	846.77
7	857.99 863.25 0.0000 0.0001	191	12	24	859.11	3.12	3.33	Tl-208	860.56
8	908.38 914.07 0.0000 0.0000	254	-25	30	911.19	0.29	0.50	Ac-228	911.20
9	966.21 971.90 0.0001 0.0001	188	26	24	969.38	0.40	0.58	Ac-228	968.97
10	998.19 1003.88 0.0015 0.0010	206	35	25	1001.14	1.24	1.49	Pa-234M	1001.03
11	1059.08 1065.21 match!	171	2	25	1062.33	0.29	0.61	No close library	
12	1117.34 1123.47 0.0043 0.0001	1771	1626	46	1120.10	1.45	2.47	Bi-214	1120.29
13	1170.34 1176.47 0.0000 0.0000	164	9	24	1175.27	0.84	0.99	Co-60	1173.24
14	1235.17 1241.30 0.0041 0.0002	688	553	32	1237.95	1.55	2.36	Bi-214	1238.11
15	1269.55 1276.12 match!	137	-8	24	1270.87	3.39	3.68	No close library	
16	1329.34 1335.91 0.0000 0.0000	136	-19	25	1330.65	3.94	4.07	Co-60	1332.50
17	1457.88 1464.45 0.0005 0.0001	210	96	23	1461.21	1.16	2.43	K-40	1461.00
18	1761.13 1768.13 0.0056 0.0002	1407	1341	40	1764.29	2.12	3.36	Bi-214	1764.49



CS-137.Rpt

Detector #2 ACQ 05-Jul-2016 at 11:37:42 RT = 210.9 LT = 209.9
 Rad Chem 2
 CS-137 START CAL

ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
1	606.93 611.75 0.0002 0.0001	27	23	5	609.09	0.29	0.82	Bi-214 609.31
2	659.29 664.11 0.0339 0.0005	5664	5541	76	661.60	1.33	1.97	Cs-137 661.66
3	724.58 729.84	1	-3	3	Could not properly fit the peak.			
4	765.77 771.02	0	0	0	Could not properly fit the peak.			
5	823.38 828.64	1	1	1	Could not properly fit the peak.			
6	843.53 848.79	0	0	0	Could not properly fit the peak.			
7	857.99 863.25	0	0	0	Could not properly fit the peak.			
8	908.38 914.07	2	2	1	Could not properly fit the peak.			
9	966.21 971.90	0	0	0	Could not properly fit the peak.			
10	998.19 1003.88 0.0018 0.0009	2	2	1	1002.79	0.22	0.35	Pa-234M1001.03
11	1059.08 1065.21	1	1	1	Could not properly fit the peak.			
12	1117.34 1123.47	0	0	0	Could not properly fit the peak.			
13	1170.34 1176.47	5	5	2	Could not properly fit the peak.			
14	1235.17 1241.30	0	0	0	Could not properly fit the peak.			
15	1269.55 1276.12	0	0	0	Could not properly fit the peak.			
16	1329.34 1335.91	0	0	0	Could not properly fit the peak.			
17	1457.88 1464.45	1	1	1	Could not properly fit the peak.			
18	1761.13 1768.13	0	0	0	Could not properly fit the peak.			

Table B-17 – Results of Dixon r tests applied to laboratory mean results

Material	Isotope	Set	No. sets	Test ratio	Critical	Value, r**
					P = 10%	P = 5%
UTS-1	^{210}Pb	Lab-7	7	.63	.51	.57
UTS-1	^{228}Ra	Lab-5*	4	.90	.77	.82
UTS-2	^{210}Pb	Lab-7	7	.63	.51	.57
UTS-4	^{230}Th	Lab-3	7	.71	.51	.57

*Test result overruled; set means of the other three sets were judged to be fortuitously close.

**Relevant probabilities are twice values for predesignated end of the set values (B2).

Table B-18 – Consensus values and related statistical parameters for isotope activities in tailings reference materials

Isotope	Consensus value, [CL], Bq g^{-1} ^a (No. sets, No. values, RSD (%), CV(%))			
	UTS-1	UTS-2	UTS-3	UTS-4
^{230}Th	3.6 [3.0 – 4.2] (7,28,21,10)	4.4 [3.3 – 5.5] (2,79,26,24)	11.3 [10.5 – 12.1] (7,29,9,5)	22.9 ^b [20.3 – 25.5] (6,24,13,7)
^{226}Ra	3.67 [3.52 – 3.82] (8,31,9,7)	5.6 [6.2 – 6.0] (8,37,13,8)	13.3 [12.7 – 13.9] (8,30,11,6)	38.6 [36.2 – 40.9] (6,33,9,5)
^{210}Pb	3.25 ^b [3.03 – 3.47] (6,23,9,7)	4.55 ^b [4.36 – 4.75] (6,39,12,9)	12.6 [12.1 – 13.2] (7,30,9,7)	32.4 [29.6 – 35.3] (7,26,9,4)
^{210}Po	3.1 [2.7 – 3.5] (6,27,10,4)	4.4 [3.7 – 5.1] (6,29,14,6)	11.8 [10.8 – 12.9] (6,29,8,4)	30.8 [25.8 – 35.9] (6,28,14,4)
$^{232}\text{Th}^{\text{c},\text{d}}$	.68 [.59 – .77] (5,18,16,11)	.88 [.67 – 1.08] (5,19,24,17)	(.16 ± .04)	(.48 ± .06)
^{228}Ra	.68 [.47 – .89] (4,14,19,10)	1.0 [0.7 – 1.4] (4,15,17,6)	–	–
$^{228}\text{Th}^{\text{d}}$	.71 [.58 – .84] (5,20,21,13)	.92 [.58 – 1.25] (5,21,29,11)	(.16 ± .04)	(.23 ± .04)
$^{231}\text{Pa}^{\text{d}}$	(.21 ± .03)	(.37 ± .05)	(.70 ± 1.0)	(2.4 ± .3)

a. CL = statistical uncertainty range at 95% confidence level, RSD = relative standard deviation of individual results (%), CV = average within-laboratory rel. std. dev. (%).

b. Data are exclusive of an outlying set.

c. ^{232}Th results from alpha spectrometry only. ^{232}Th concs. by NAA are incorporated with chemical results.

d. Single laboratory results and uncertainty estimates in brackets are for information only.



National Institute of Standards & Technology Certificate

Standard Reference Material® 4353A

Rocky Flats Soil Number 2

This Standard Reference Material (SRM) has been developed in cooperation with member laboratories of the International Committee for Radionuclide Metrology and other experienced metrology laboratories. The SRM consists of approximately 90 grams of air-dried, pulverized soil in a polyethylene bottle. The SRM is intended: for use in tests of measurements of radioactivity contained in matrices similar to the sample, for evaluating analytical methods, and as a generally available calibrated "real" sample matrix for laboratory intercomparison.

Radiological Hazards: This SRM contains low levels of anthropogenic and natural radioactivity and poses no radiological hazard. The SRM should be used only by qualified persons.

Chemical Hazards: The SRM is a dried sterilized soil and poses no chemical or biological hazard. However, inhalation or ingestion of the material should be avoided.

Storage and Handling: The SRM should be stored in a dry location at room temperature. The bottle should be shaken before opening in a chemical hood and should be recapped tightly as soon as subsamples are removed. The bottle (or any subsequent container) should always be clearly marked. If the SRM is transported, it should be packed, marked, labeled, and shipped in accordance with applicable national, international, and carrier regulations.

Preparation: This Standard Reference Material was prepared under the leadership of the Physics Laboratory, Ionizing Radiation Division, Radioactivity Group, Michael Unterweger, Acting Group Leader. The overall technical direction leading to the certification of this SRM was provided by Svetlana Nour and Kenneth G.W. Inn of the Radioactivity Group.

Statistical support was provided by James J. Filliben of the Information Technology Laboratory, Statistical Engineering Division.

The support aspects involved in the preparation, certification, and issuance of this SRM were coordinated through the NIST Measurement Services Division.

Technical Contacts: Svetlana Nour (e-mail: svetlana.nour@nist.gov; phone: 1-301-975-4927) and Kenneth G.W. Inn (e-mail: kenneth.inn@nist.gov; phone: 1-301-975-5541), NIST, Building 245, Room C114, Gaithersburg, MD 20899-8462, fax 1-301-926-7416.

Lisa Karam, Deputy Chief
Ionizing Radiation Division

Gaithersburg, Maryland 20899
July 2007

Robert L. Watters, Jr., Chief
Measurement Services Division

Details of the SRM preparation: This SRM is from the Rocky Flats Plant in north-central Colorado. The material was obtained from Rockwell International's Rocky Flats Plant (RFP) by the National Institute of Standards and Technology (NIST) of the U.S. Departments of Commerce and by the Environmental Measurements Laboratory (EML) of the U.S. Department of Homeland Security. The material was first coarsely sieved in the field to remove rocks larger than about 1.5 cm diameter. After air drying, the soil was blade milled twice. The soil was pulverized with a "pancake" style air jet mill to an average particle diameter of 8 μm . More than 99 percent, by weight, of the particles are less than 20 μm in diameter. The SRM was "V-cone" blended to optimize homogeneity and bottled in polyethylene bottles. The final bottled SRM was sterilized with > 50 kGy of ^{60}Co radiation to satisfy export regulations and to increase shelf-life time.

Instructions for Drying: When nonvolatile radionuclides are to be determined, working samples of this SRM should be dried at 40°C for 24 hours prior to weighing. Volatile radionuclides (e.g., ^{210}Po , ^{137}Cs , ^{210}Pb , ^{212}Pb and ^{214}Pb) should be determined on samples as received. Separate samples should be dried as previously described to obtain a correction factor for moisture. Correction for moisture content is to be made to the data for volatile radionuclides before comparing with the values given by this certificate. This procedure ensures that these radionuclides are not lost during drying (see Reference [1]*). The weight loss on drying is typically less than 4 percent.

Heterogeneity: Twenty-three bottles of the SRM were examined for gamma-ray heterogeneity by measuring their emission rates by counting them on a "5-in" (12.7 cm) NaI(Tl) detector coupled to a multichannel analyzer. The count rates from each measurement were analyzed for statistical difference for ten selected energy regions, and no detectable heterogeneity was observed.

This material has also been measured for alpha-particle emitting radionuclides using sample sizes of 1 gram to 100 grams. There are variations of results due to sample size. Based on over 100 plutonium and ^{241}Am measurements it was concluded that the material contains "hot" particles, and it is recommended that a sample size of 5 grams to 10 grams be used for radiochemical analysis and a sample size of 30 grams to 100 grams for gamma isotopic analysis. Statement of uncertainties, tolerance limits, and ranges of reported results incorporate the effects of heterogeneity.

Material Stability and Changes in Certified Values: This matrix is considered to be stable; however, its stability has not been rigorously assessed. NIST will monitor this material and will report any substantive changes in certification to the purchaser. Return of the enclosed registration card is mandatory to receive such notifications. The properties of the SRM are given in Table 1.

Calculation of Certified Massic Activity Values: The certified massic activity value for each nuclide (see Tables 2, 3 and 4) was determined from the evaluated average of the individual laboratory means. This approach was selected because of the well-behaved normal distribution of the laboratories' data.

Calculation of the Uncertainties for the Certified Values: The standard combined uncertainties (u_c) for each of the certified values were computed by incorporating components from three sources: 1) the estimated standard deviation of the mean of the laboratory mean values, 2) the $k = 1$ uncertainty associated with the radiochemical tracer SRMs, and 3) Type B scientific judgment. The uncertainty components were combined in quadrature as specified by the GUM. The expanded uncertainties (U) were computed using the Welch-Satterthwaite coverage factor. The expanded uncertainty (U) is taken as the 95 percent confidence interval.

Calculation of Certified Tolerance Limits: In addition to the certified massic activities and activity ratios, and their respective uncertainty values, Tables 2, 3, and 4 also provide 95/95 (normal) tolerance limits. Whereas the certified value is the mean of the population of measurements of the SRM and the expanded uncertainty for the certified value is at the 95 percent confidence limit, the tolerance limits are a measure of the spread of the population of measurements across the SRM. A 95/95 tolerance limit means that NIST is 95% confident that 95% of the population of SRM measurements fall within the specified limits. The tolerance limits are used when the number of replicates is small ($n < 5$), e.g., when the material is used as a periodic QC sample. For guidance on the use of tolerance limits in connection with this SRM, see Appendix 1.

Uncertified Massic Activities and Mass Ratios: The massic activities and mass ratios for the radionuclides given in Table 5 and 6 are not certified at this time, but may be certified at some future time if additional data become available. Users are invited to submit measurement data to contribute to the certification process. The data should be sent to one of the technical contacts listed on page 1.

Elemental Composition: Semi-quantitative elemental analysis of the Rocky Flats Number 2 matrix is listed in Table 8.

Table 1: Properties of SRM 4353A.

Certified Properties	
Radionuclides	See Table 2, 3 and 4
Reference time	1 April 1998
Certified massic activities	See Table 2, and 3
Certified activity ratios	See Table 4
Uncertainties (See Note 1)*	See Table 2, 3 and 4
Tolerance Limits	See Table 2, 3 and 4

Uncertified Properties

Source description	Rocky Flats Soil Number 2, approximately 90 g in a polyethylene bottle
Uncertified massic activities	See Table 5
Uncertified activity ratios	See Table 6
Range of reported values	See Tables 5 and 6
Half-lives used	See Table 7
Radiochemical and detection methods	See Table 7 and 9
Elemental composition	See Table 8
Participating laboratories and personnel	See Table 7 and 10

Table 2: Certified Massic Activities.[†]

Radionuclide	Massic Activity and uncertainty (mBq·g ⁻¹) (See Note 2)*	95/95 Tolerance Limit (mBq·g ⁻¹) (See Note 3)
²³⁸ Pu	0.278 ± 0.041	0.18 to 0.51
^{239,240} Pu	16.8 ± 1.8	6.0 to 26.8
²³⁸ U	39.6 ± 3.0	31.9 to 48.1
²³⁴ U	40.4 ± 3.0	33.7 to 47.7
²³⁵ U	1.88 ± 0.53	0.82 to 2.68
⁹⁰ Sr	10.5 ± 1.3	6.5 to 15.1

[†] Recommended sample size of at least 5 grams for radiochemical analysis. Refer to table 7 for uncertified information.

Table 3: Certified Massic Activities.[‡]

Radionuclide	Massic Activity and uncertainty (mBq·g ⁻¹) (See Note 2)	95/95 Tolerance Limit (mBq·g ⁻¹) (See Note 3)
¹³⁷ Cs	21.6 ± 2.6	13.7 to 30.0
²²⁸ Ra (See Note 4)	74.9 ± 7.5	61.4 to 91.6
²¹⁰ Pb	58.0 ± 9.9	41.8 to 79.7

[‡] Recommended sample size of at least 30 grams for gamma-ray measurement. Refer to table 7 for uncertified information.

Table 4: Certified Activity Ratios.[†]

Radionuclides Ratio	Ratio and uncertainty	95/95 Tolerance Limit (See Note 3)
²³⁴ U / ²³⁸ U	1.028 ± 0.036	0.92 to 1.14
²³⁸ Pu / (²³⁹ Pu+ ²⁴⁰ Pu)	0.017 ± 0.001	0.013 to 0.020
²²⁸ Th / ²³² Th	1.01 ± 0.10	0.84 to 1.14
²³⁰ Th / ²³² Th	0.671 ± 0.067	0.55 to 0.76

[†] Refer to table 7 for uncertified information.

Table 5: Uncertified Massic Activities.[†]

Radionuclide	Massic Activity (mBq·g⁻¹)	Lower and Upper Values of Reported Results (mBq·g⁻¹)
²²⁸ Th	72.4	61.6 to 88.4
²³⁰ Th	47.9	40.9 to 57.8
²³² Th	73.6	62.1 to 90.2
²³⁴ Th	60.1	28.9 to 103.3
²²⁶ Ra	42.4	28.4 to 52.7
²¹⁴ Pb	43.2	34.9 to 51.9
²¹⁴ Bi	40.6	28.4 to 53.2
²¹² Pb	90.2	83.3 to 95.7
²¹² Bi	79.5	68.8 to 87.3
²⁰⁸ Tl	51.3	26.8 to 67.7
⁴⁰ K	589	533 to 719
²⁴¹ Pu	17.0	13.0 to 30.0
²⁴¹ Am (alpha spectrometry)	2.5	0.6 to 5.4
²⁴¹ Am (gamma spectrometry)	4.7	3.7 to 6.6

[†] Radionuclides for which insufficient numbers of data sets or for which unresolved discrepant data sets were obtained. No uncertainties are provided because no meaningful estimates could be made. Refer to table 7 for uncertified information.

Table 6: Uncertified Mass Ratios.[‡]

Radionuclides	Mass Ratio	Lower and Upper Values of Reported Results
²⁴⁰ Pu / ²³⁹ Pu	$5.6 \cdot 10^{-2}$	$(5.3 \text{ to } 6.0) \cdot 10^{-2}$
²⁴¹ Pu / ²³⁹ Pu	$5.8 \cdot 10^{-4}$	$(0.4 \text{ to } 1.3) \cdot 10^{-3}$
²⁴¹ Pu / ²⁴⁰ Pu	$1.0 \cdot 10^{-2}$	$(0.8 \text{ to } 2.3) \cdot 10^{-2}$

[‡] Ratios for which insufficient numbers of data sets or for which unresolved discrepant data sets were obtained. No uncertainties are provided because no meaningful estimate could be made. Refer to table 7 for uncertified information.

Table 7: Uncertified Information for Tables 2 through 6.

Radionuclides	Number of Laboratories (and total assays)	Half Life (See Note 5)*	Methods (Table 9)	Contributing Laboratories Acronym (Table 10)
^{238}Pu	14 (169)	(87.7 ± 0.1) a	2b, 3b	BIL-GSL, CEMRC, EML, FSU, GSF, IAEA, LANL, NIST, OSU, RESL, SRNL, WHOI
$^{239,240}\text{Pu}$	14 (172)	(24110 ± 30) a (6561 ± 7) a	2b, 3b	BIL-GSL, CEMRC, EML, FSU, GSF, IAEA, LANL, NIST, OSU, RESL, SRNL, WHOI
^{238}U	7 (72)	$(4.468 \pm 0.003) 10^9$ a	2b, 3b, 3 e	CEMRC, EML, FSU, NIST, RESL, SRNL,
^{234}U	7 (72)	$(2.455 \pm 0.006) 10^5$ a	2b, 3b	CEMRC, EML, FSU, NIST, RESL, SRNL,
^{235}U	4 (38)	$(7.04 \pm 0.01) 10^8$ a	2b, 3b	CEMRC, EML, NIST, SRNL,
^{90}Sr	5 (38)	(28.79 ± 0.06) a	2c, 3c	EML, IAEA, RESL, WHOI
^{137}Cs	9 (82)	(30.07 ± 0.03) a	1a	BIL-GSL, EML, FSU, LANL, NIST, OSU, RESL, SRNL, WHOI
^{228}Ra (Note 4)	5 (42)	(5.75 ± 0.03) a	1a	BIL-GSL, FSU, NIST, RESL, SRNL
^{210}Pb	3 (24)	(22.20 ± 0.22) a	1a	FSU, NIST, SRNL
$^{234}\text{U} / ^{238}\text{U}$	8 (87)	$(2.455 \pm 0.006) 10^5$ a $(4.468 \pm 0.003) 10^9$ a	2b, 2e	BIL-GSL, CEMRC, EML, FSU, NIST, RESL, SRNL
$^{238}\text{Pu} / (^{239}\text{Pu} + ^{240}\text{Pu})$	14 (169)	(87.7 ± 0.1) a (24110 ± 30) a (6561 ± 7) a	2b	BIL-GSL, CEMRC, EML, FSU, GSF, IAEA, LANL, NIST, OSU, RESL, SRNL, WHOI,
$^{228}\text{Th} / ^{232}\text{Th}$	3 (27)	(1.9116 ± 0.0016) a $(1.40 \pm 0.01) 10^{10}$ a	2b	CEMRC, NIST, RESL
$^{230}\text{Th} / ^{232}\text{Th}$	3 (27)	$(7.538 \pm 0.030) 10^4$ a $(1.40 \pm 0.01) 10^{10}$ a	2b	CEMRC, NIST, RESL
^{228}Th	3 (27)	(1.9116 ± 0.0016) a	2b, 3b	CEMRC, NIST, RESL
^{230}Th	3 (27)	$(7.538 \pm 0.030) 10^4$ a	2b, 3b	CEMRC, NIST, RESL
^{232}Th	4 (42)	$(1.40 \pm 0.01) 10^{10}$ a	2b, 3b, 3 e	CEMRC, IAEA, NIST, RESL
^{234}Th	2 (21)	(24.10 ± 0.03) d	1a	FSU, SRNL
^{226}Ra	4 (38)	(1600 ± 7) a	1a	BIL-GSL, FSU, RESL, SRNL
^{214}Pb	3 (21)	(26.8 ± 0.9) min	1a	BIL-GSL, FSU, SRNL
^{214}Bi	3 (32)	(19.9 ± 0.4) min	1a	BIL-GSL, FSU, SRNL
^{212}Pb	1 (15)	(10.64 ± 0.01) h	1a	SRNL
^{212}Bi	1 (15)	(60.55 ± 0.06) min	1a	SRNL
^{208}Tl	3 (33)	(3.053 ± 0.004) min	1a	BIL-GSL, FSU, SRNL
^{40}K	2 (30)	$(1.248 \pm 0.003) 10^9$ a	1a	BIL-GSL, SRNL
^{241}Pu	2 (20)	(14.290 ± 0.006) a	2d	IAEA
$^{241}\text{Am} (\alpha \text{ spectrometry})$	13 (115)	(432.6 ± 0.6) a	2b, 3b	BIL-GSL, CEMRC, EML, FSU, IAEA, LANL, NIST, OSU, RESL, SRNL, WHOI

Table 7 (cont.): Uncertified Information for Tables 2 through 6.

Radionuclides	Number of Laboratories (and total assays)	Half Life (See Note 5)*	Methods (Table 9)	Contributing Laboratories Acronym (Table 10)
^{241}Am (γ spectrometry)	3 (24)	(432.6 ± 0.6) a	1a	FSU, NIST, SRNL
$^{240}\text{Pu} / ^{239}\text{Pu}$	1 (15)	(24110 ± 30) a (6561 ± 7) a	2e	SRNL
$^{241}\text{Pu} / ^{239}\text{Pu}$	1 (15)	(14.290 ± 0.006) a (6561 ± 7) a	2e	SRNL
$^{241}\text{Pu} / ^{240}\text{Pu}$	1 (15)	(14.290 ± 0.006) a (24110 ± 30) a	2e	SRNL

Table 8: Elemental Composition Based on Semi-quantitative X-Ray Fluorescence (XRF) analysis[†]. These values are not certified.

Element	Percent by mass (%)	Element	Percent by mass (%)
Si	36	Cl	0.004
Al	4.5	Cr	0.033
Fe	2.6	Cu	0.003
Mg	0.29	Ga	<0.001
Ca	0.40	Ni	0.018
Na	0.65	Pb	0.003
K	1.7	Rb	0.007
Ti	0.20	Sr	0.011
P	0.07	V	0.004
Mn	0.054	Y	0.002
C	1.5	Zn	0.007
S	0.02	Zr	0.02

[†]The estimated relative combined standard uncertainty for each reported concentration is from -33 % to +50 %. Data presented by John Sieber, Chemical Science and Technology Laboratory (CSTL).

Table 9: Radiochemical and Detection Methods.

1	Non-destructive
2	Fusion/total decomposition
3	Acid leach (any combination of the following HNO_3 , HCl , HF , HClO_4)
a	Germanium gamma-ray spectrometer
b	Silicon surface-barrier alpha-particle spectrometer
c	Beta-particle counter
d	Liquid scintillation counter
e	Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS), Atomic Mass Spectroscopy (AMS)

Table 10: Participating Laboratories and Personnel.

Laboratory Acronym	Laboratory	Country	Technical Contact
BIL - GSL	British Nuclear Group Sellafield Ltd.	United Kingdom	Dr. M. Froggatt
CEMRC	Carlsbad Environmental Monitoring & Research Center	United States of America	Dr. B. Stewart
EML	Environmental Measurements Laboratory	United States of America	Dr. H. Volchok, M. Feiner
FSU	Florida State University	United States of America	Dr. W. Burnett
GSF	National Research Center for Environment and Health, Institute of Radiation Protection	Germany	Dr. K. Bunzl
IAEA †	International Atomic Energy Agency	Austria	Dr. J. Moreno, Dr. K. Burns, Dr. G. Kis-Benedek
LANL	Los Alamos National Laboratory	United States of America	Dr. D. Decker, Dr. N. Koski, Dr. S.R. Garcia
NIST	National Institute of Standards and Technology	United States of America	S. Nour, Dr. K. Inn
OSU	Oregon State University	United States of America	Dr. T. Beasley
RESL †	Radiological and Environmental Sciences Laboratory (RESL)	United States of America	Dr. D. Olson, Dr. S. Bohrer
SRNL	Savannah River National Laboratory	United States of America	J. Cadieux
WHOI	Woods Hole Oceanographic Institution	United States of America	Dr. V. Bowen, Dr. H. Livingston

† Note: These laboratories participated twice, reporting two sets of data.

Appendix 1

Recommendations on the use of the certified values for validation of measurements or methods

Case 1. Single Observation

Recommendation.

If a single observation is made, check to see if that value is within the certified 95/95 (95% confidence / 95% coverage) tolerance interval as provided in column 3 of Tables 2, 3, and 4 . If yes, then conclude that the measurement/method process is acceptable; if no, then conclude that the process is questionable and adjust accordingly.

Example.

A laboratory analyzed ^{235}U with a single measurement of this SRM to validate its method. The measured result was 1.86 mBq/g. The NIST certified value (see column 2 of Table 2) is 1.88 mBq/g. Is the laboratory method valid?

Procedure.

Check to determine if the measured value 1.86 is within the tolerance interval as provided in column 3 of Table 2. The tolerance interval for ^{235}U is (0.82, 2.68). Since 1.86 falls within this interval, then conclude that no evidence exists that this process is invalid (that is, in practice, we conclude that the process is valid).

Case 2. Multiple Observations

Recommendation.

If multiple observations are made, then:

1. check that at least 95% of the data points are within the provided tolerance interval (if yes, then accept the process; otherwise, reject the process);
2. check (via the appropriate t-test) that the mean of the collected data points is "close enough" to the provided certified value.

Example.

A laboratory analyzed ^{235}U in 5 replicates of this SRM to validate its method. The analytical results were 1.86, 1.99, 1.85, 1.87, and 1.86 mBq/g. The NIST certified value is 1.88 mBq/g. Is the laboratory method valid?

Procedure.

1. Check to determine the proportion of the 5 measured values that are within the 95/95 tolerance interval (0.82, 2.68) as provided in column 3 of Table 2 (at least 95% of the 5 values should fall within). Since 5 out of 5 of the values fall within the interval, then we conclude that the process is valid.
- 2: Compare the mean of the 5 collected points (1.866) with the certified value (1.88) by performing the t-test .

2.1. NIST's Certified Value:

$$m = 1.88 \text{ mBq/g (see Table 2)}$$

2.2. Compute Laboratory Data Summary Statistics:

Sample size	$n = 5$
Sample mean	$x = 1.866 \text{ mBq/g}$
Sample standard deviation	$s = 0.015 \text{ mBq/g}$
Significant level of the t-test	$\alpha = 0.05$

2.3. Compute t-test Statistic Value:

$$\begin{aligned} \text{t-test statistic value} &= (x - m)/(s/(n)^{1/2}) \\ &= (1.866 - 1.88)/(0.015/(5)^{1/2}) \\ &= -2.064 \end{aligned}$$

2.4. Determine Cutoff Values for 95 % Confidence:

Upper 2.5% point of $t_{(n-1)}$ distribution = 2.776 (See Table A1)
 Lower 2.5% point of $t_{(n-1)}$ distribution = -2.776 (See Table A1)

3. Conclusions:

- 3.1 If test statistic value < lower cutoff value, then conclude method is invalid with negative bias relative to the certified value.
- 3.2 If test statistic value > upper cutoff value, then conclude method is invalid with positive bias relative to the certified value.
- 3.3 If neither of the above, then conclude method is valid.

Example's Conclusion:

Since the laboratory's test statistic value of -2.064 is neither > the upper cutoff value of 2.776 nor < the lower cutoff value of -2.776, case 3 applies and it can be concluded that the laboratory's method for ^{235}U analysis is valid.

Table A1: Probability points of the t distribution with (n-1) degrees of freedom.

Degrees of freedom (n-1)	Tail area probability, $t_{(n-1)}$ (cutoff values)	
	Upper 2.5 %	Lower 2.5 %
1	12.706	-12.706
2	4.303	-4.303
3	3.182	-3.182
4	2.776	-2.776
5	2.571	-2.571
6	2.447	-2.447
7	2.365	-2.365
8	2.306	-2.306
9	2.262	-2.262
10	2.228	-2.228

NOTES FOR TABLES 1, 2, 3 AND 7

- Note 1. For further information on the expression of uncertainties, see references [3] and [4].
- Note 2. The mean is the evaluated reference value from measurement results by the participating laboratories. The stated uncertainty is the 95% confidence interval based on a student-t distribution.
- Note 3. The tolerance limits are for 95 percent confidence and 95 percent coverage. Differences between laboratories have been eliminated so that the given limits reflect only between-measurement differences.
- Note 4. Radium-228 activity values are based on measurements of its ^{228}Ac daughter.
- Note 5. The stated uncertainty of the half-life is the standard uncertainty. See reference [5].

REFERENCES

- [1] R. Bock, *A Handbook of Decomposition Methods in Analytical Chemistry*, International Textbook Company, Limited. T. & A. Constable Ltd., Great Britain, 1979.
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- [3] International Organization for Standardization (ISO), *Guide to the Expression of Uncertainty in Measurement*, 1993. Available from the American National Standards Institute, 11 West 42nd street, New York, NY 10036, USA. 1-212-642-4900. (Listed under ISO miscellaneous publications as "ISO Guide to the Expression 1993".)
- [4] B.N. Taylor and C.E.Kuyatt, *Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results*, NIST Technical Note 1297, 1994. Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402, USA.
- [5] Evaluated Nuclear Structure Data File (ENSDF), online database, National Nuclear Data Center, Brookhaven Laboratory (Upton, NY), November 2006. Refer to <http://www.nndc.bnl.gov/ensdf/>



CANADA CENTRE FOR MINERAL AND ENERGY TECHNOLOGY

REFERENCE URANIUM-THORIUM ORE DL-1a

CERTIFICATE OF ANALYSIS

	Recommended Value	95% Confidence Interval
U	0.0116%	± 0.0003%
Th	0.0076%	± 0.0004%
Ra-226	1.40 Bq/g	± 0.04 Bq/g
Pb-210	1.40 Bq/g	± 0.02 Bq/g

DESCRIPTION

DL-1a is intended as a replacement for DL-1 of which the stock is exhausted. It is waste rock typical of the property of Denison Mines Limited in Elliot Lake, Ontario, and is a pale yellow arkose sandstone containing uraninite and brannerite and possibly traces of monazite and uranothorite. The bulk material was dry-ground to minus 74 µm, blended, sampled systematically for analysis by optical fluorimetric and chemical methods to demonstrate homogeneity suitable for use as a reference material, and bottled in 200-g units. Evidence is available that DL-1a is in secular equilibrium.

CERTIFICATION

The consensus value for uranium is the unweighted mean of 286 accepted analytical determinations by 20 laboratories. Methods included titrimetry, colorimetry, fluorimetry, X-ray fluorescence, neutron activation analysis and radiochemistry.

The consensus value for thorium is the unweighted mean of 187 accepted analytical determinations by 14 laboratories. Methods included colorimetry, X-ray fluorescence, neutron activation analysis, radiometry and isotope dilution-mass spectrometry.



NON-CERTIFIED CONSTITUENTS

The concentration of the following constituents are given for information only.

	Value
Fe	0.93%
S	0.41%

INSTRUCTIONS FOR USE

The recommended values for DL-1a pertain to an "as is" basis.

LEGAL NOTICE

The Canadian Certified Reference Materials Project has prepared this reference material and statistically evaluated the analytical data for the interlaboratory certification program to the best of its ability. The Purchaser by receipt hereof releases and indemnifies the Canadian Certified Reference Materials Project from and against all liability and costs arising out of the use of this material and information.

REFERENCE

The preparation and certification procedures used for DL-1a are given in CANMET Reports 80-10 "DL-1a: A Certified Uranium-Thorium Reference Ore", 83-9E "Radium-226 in Certified Uranium References Ores DL-1a, BL-4a, DH-1a and BL-5" and 84-11E "Lead-210 in Certified Uranium Reference Ores DL-1a, BL-4a, DH-1a and BL-5" which are available free of charge on application to:

Coordinator, CCRMP

CANMET

555 Booth Street

Ottawa, Ontario K1A OG1

Canada

This Certificate of Analysis is available in French on request to the Coordinator, CCRMP.

Inter-Mountain Laboratories - RadChem Standards Notebook

Date: 1/28/16	Standard: Radium 226 11.06g Radium 226 standard 7.5 mL 2mL Nitric Acid (2014093036) was brought up to 100mL DI	pCi/mL L for 1/4mL 5.54 pCi/mL L	RADSTD-15-1
Expires: 1/28/17	Reference Date: 1/1/07		Initials: mB
Date: 2/16/16	Standard: Po-210 standard 0.3259g Po-210 (182341) and 2mL Nitric Acid (2014093036) was brought up to 100mL DI	pCi/mL L 2/16/17 24,778-22,804 pCi/mL L	RADSTD-15-2
Expires: 2/16/17	Reference Date: 8/1/15 11:00 MST		Initials: ms
Date: 3/10/16	Standard: DL-1a Canned DL-1a - 150.02 grams	pCi/mL L	RADSTD-15-3
Expires: Never	Reference Date:		Initials: T.P.
Date: 3/21/16	Standard: Thorium 229 0.9441g thorium 229 (SRM4328C) and 4mL nitric (2014093036) was brought up to 200mL DI	pCi/mL L	RADSTD-15-4
Expires: 3/31/17	Reference Date: 12/31/07 / EST 12:00		Initials: mB
Date: 3/31/16	Standard: Radium 228 standard 2.8902g Radium 228 (43395) and 4mL Nitric Acid (2014093036) brought up to 200mL DI	39.48 pCi/mL L	RADSTD-15-5
Expires: 3/31/16	Reference Date: 10/7/16 12:00 EST		Initials: mB
Date: 4/15/16	Standard: Radium -222 1mL RADSTO 1-1 and 9mL DI and scintilliator oil 10mL	pCi/mL L	RADSTD-15-6
Expires:	Reference Date: 9/9/1991 12:00 EST		Initials: ms
Date: 4/18/16	Standard: BL-4A Canned BL-4A + 57.73 157.39 3 made	pCi/mL L	RADSTD-15-7
Expires: Never	Reference Date:		Initials: mB

ILE

om Page No. _____

Preparation of Radium 226
 Standard from UTS-4
 by Tom Potts 11-12-10

OHAUS Balance check with weights 54106

$$\begin{aligned}100\text{ g} &= 100.01\text{ g} \\50\text{ g} &= 50.00 \\5\text{ g} &= 5.00\end{aligned}$$

TARE 190.20 grams Sand \Rightarrow 211.35g

UTS-4 = 5.00 grams

Total weight = 195.20 grams

Canned & Sealed 11-12-10

UTS-4-CAN

Homogenized with a loss of 0.04 grams 1.8.

To Page No. _____

nessed & Understood by me,

65 of 88

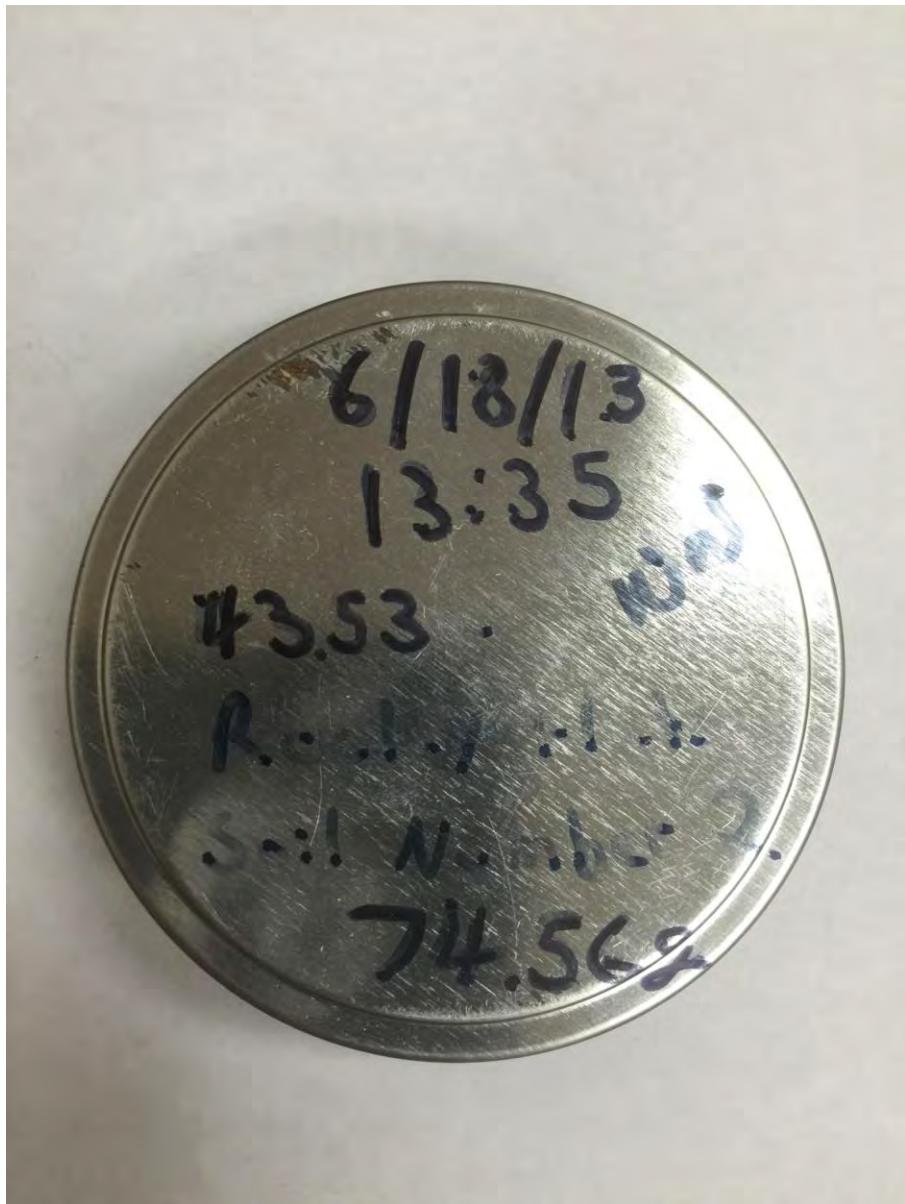
Date

Invented by

Date

S1607011001

Recorded by



RADSTD15.3-2HRS.Rpt

Detector #2	ACQ	19-Jun-2016 at 10:50:05	RT =	7238.5	LT =	7200.0		
Rad	Chem	2						
RADSTD15-2HRS								
ROI#	RANGE(keV)	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
μCi	+/-							
1	606.93 611.75 0.0050 0.0000	17537	16502	139	609.13	1.28	1.98	Bi-214 609.00
2	659.29 664.11 0.0000 0.0000	609	-43	42	661.15	0.38	0.55	Cs-137 661.66
3	724.58 729.84 0.0015 0.0001	1143	643	47	727.03	1.25	2.34	Bi-212 727.00
4	765.77 771.02	2161	1290	63	768.15	1.22	1.97	No close library
match!								
5	857.99 863.25	757	290	42	860.43	1.07	2.17	No close library
match!								
6	908.38 914.07 0.0012 0.0000	2273	1598	62	910.92	1.43	2.25	Ac-228 911.00
7	966.21 971.90 0.0013 0.0001	1509	1027	52	968.73	1.47	2.33	Ac-228 968.97
8	998.19 1003.88	623	200	40	1000.67	1.44	2.05	No close library
match!								
9	1059.08 1065.21 0.0000 0.0000	420	62	37	1064.21	0.68	1.35	Bi-207 1063.00
10	1117.34 1123.47	3766	3307	71	1119.99	1.63	2.50	No close library
match!								
11	1170.34 1176.47 0.0000 0.0000	359	69	34	1173.51	0.54	1.05	Co-60 1173.20
12	1235.17 1241.30	1582	1219	51	1237.76	1.55	2.50	No close library
match!								
13	1269.55 1276.12	364	80	35	1273.73	0.33	1.17	No close library
match!								
14	1329.34 1335.91	321	26	35	1333.69	0.27	0.48	No close library
match!								
15	1457.88 1464.45	1476	1083	52	1460.38	1.87	2.84	No close library
match!								
16	1761.13 1768.13	2905	2679	60	1764.00	2.04	3.05	No close library
match!								

RADSTD15.3-2HRS-2.Rpt

Detector #2	ACQ	22-Jun-2016 at 12:53:53	RT = 7237.1	LT = 7200.0						
Rad	Chem	2								
RADSTD15-3.2HRS										
ROI#	RANGE(keV)	GROSS	NET	+/-						
Bq	+/-									
1	606.93 182.18	611.75 1.54	17314	16336	138	609.07	1.27	1.96	Bi-214	609.00
2	659.29 0.00	664.11 0.28	634	-45	43	660.17	0.22	0.35	Cs-137	661.66
3	724.58 53.25	729.84 4.35	1220	612	50	726.95	1.40	2.00	Bi-212	727.00
4	765.77	771.02	2118	1218	63	768.10	1.18	2.00	No close library	
match!										
5	857.99	863.25	799	295	43	860.23	1.36	1.99	No close library	
match!										
6	908.38 45.50	914.07 1.64	2296	1697	61	910.83	1.54	2.32	Ac-228	911.00
7	966.21 49.38	971.90 2.33	1401	1018	48	968.60	1.33	2.25	Ac-228	968.97
8	998.19	1003.88	692	287	41	1000.87	0.86	1.85	No close library	
match!										
9	1059.08 0.33	1065.21 0.43	431	30	39	1062.20	0.31	0.58	Bi-207	1063.00
10	1117.34	1123.47	3788	3208	73	1119.96	1.57	2.44	No close library	
match!										
11	1170.34 0.26	1176.47 0.34	371	28	36	1173.63	0.24	0.38	Co-60	1173.20
12	1235.17	1241.30	1548	1181	50	1237.71	1.75	2.48	No close library	
match!										
13	1269.55	1276.12	317	-14	36	1275.27	0.46	0.71	No close library	
match!										
14	1329.34	1335.91	337	-20	38	1333.72	0.22	0.35	No close library	
match!										
15	1457.88	1464.45	1616	1197	54	1460.30	1.75	2.84	No close library	
match!										
16	1761.13	1768.13	2820	2594	60	1763.86	1.88	3.10	No close library	
match!										

MB-358.Rpt

Detector #1	ACQ	24-Dec-2015 at 10:58:28	RT = 7206.8	LT = 7200.0					
ROI#	Rad µCi	Chem 1 MB-358	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
1	607.80 0.0000	612.63 0.0000	127	35	17	609.80	0.34	0.91	Bi-214 609.31
2	660.21 0.0000	665.47 0.0000	52	-15	14	664.81	0.22	0.35	Cs-137 661.66
3	724.23 0.0000	729.94 0.0000	69	15	14	725.11	3.44	3.68	Bi-212 727.00
4	766.11 0.0001	772.03 0.0000	52	24	11	768.55	0.29	1.16	Bi-214 768.36
5	823.77 0.0000	829.47 0.0320	47	-3	13	824.65	0.22	0.35	Co-60 826.28
6	844.60 0.0000	850.30 0.0000	114	51	16	847.73	0.56	1.90	Co-56 846.77
7	857.32 0.0000	863.02 0.0000	49	-23	15	857.97	0.22	0.35	Tl-208 860.56
8	908.62 0.0000	914.32 0.0000	41	5	11	912.34	1.16	1.39	Ac-228 911.20
9	965.83 0.0000	971.97 0.0000	47	13	11	969.81	0.32	1.09	Ac-228 968.97
10	998.71 0.0001	1004.85 0.0003	37	3	11	1000.91	3.51	3.64	Pa-234M 1001.03
11	1060.09 0.0000	1066.23 0.0000	29	-10	11	Could not properly fit the peak.			
12	1118.17 0.0000	1124.31 0.0000	54	10	13	1121.06	0.35	0.95	Bi-214 1120.29
13	1170.34 0.0000	1176.48 0.0000	22	17	5	1171.00	3.07	3.20	Co-60 1173.24
14	1233.24 0.0001	1241.13 0.0001	43	18	12	1234.55	4.93	5.13	Bi-214 1238.11
15	1270.72 match!	1277.29	13	8	5	1273.78	0.33	0.53	No close library
16	1329.88 0.0002	1336.46 0.0000	24	-12	11	Could not properly fit the peak.			
17	1457.64 0.0000	1464.65	85	57	13	1461.64	0.75	2.50	K-40 1461.00
18	1762.38 0.0001	1769.83 0.0000	43	25	10	1765.67	0.65	0.79	Bi-214 1764.49

MB-11033.Rpt

Detector #1 ACQ 10-Nov-2015 at 9:24:46 RT = 7206.8 LT = 7200.0
 Rad Chem 1
 MB-297

ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
1	607.80 612.63 0.0000 0.0000	146	54	17	610.12	0.47	0.75	Bi-214 609.31
2	660.21 665.47 0.0000 0.0000	51	-3	12	661.09	0.22	0.35	Cs-137 661.66
3	724.23 729.94 0.0000 0.0000	64	1	14	727.74	0.22	0.35	Bi-212 727.00
4	766.11 772.03 0.0000 0.0001	65	4	15	768.62	0.54	1.29	Bi-214 768.36
5	823.77 829.47 0.0000 0.0271	36	-5	11	825.21	0.41	0.56	Co-60 826.28
6	844.60 850.30 0.0000 0.0000	99	58	14	847.00	0.28	0.49	Co-56 846.77
7	857.32 863.02 0.0000 0.0000	44	21	10	859.61	1.61	1.81	Tl-208 860.56
8	908.62 914.32 0.0000 0.0000	43	-7	12	911.47	1.42	1.84	Ac-228 911.20
9	965.83 971.97 0.0000 0.0000	46	12	11	968.46	1.48	1.64	Ac-228 968.97
10	998.71 1004.85 0.0001 0.0003	39	5	11	1001.34	0.22	0.35	Pa-234M 1001.03
11	1060.09 1066.23 match!	38	-1	12	1062.28	0.22	0.35	No close library
12	1118.17 1124.31 0.0000 0.0000	58	19	12	1120.96	0.80	1.27	Bi-214 1120.29
13	1170.34 1176.48 0.0000 0.0000	30	-14	12	1172.31	0.22	0.35	Co-60 1173.24
14	1233.24 1241.13 0.0000 0.0000	52	9	15	1239.27	0.42	0.83	Co-56 1238.28
15	1270.72 1277.29 match!	35	4	11	1272.25	0.27	0.48	No close library
16	1329.88 1336.46	16	0	8	Could not properly fit the peak.			
17	1457.64 1464.65 0.0002 0.0000	77	66	10	1461.86	0.53	1.83	K-40 1461.00
18	1762.38 1769.83 0.0001 0.0000	52	46	8	1766.55	0.25	0.40	Bi-214 1764.49

MB-11050.Rpt

Detector #1 ACQ 17-Nov-2015 at 15:37:14 RT = 7207.1 LT = 7200.0
 Rad Chem 1
 MB-321

ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
1	607.80 612.63 0.0000 0.0000	115	73	13	610.02	0.38	1.52	Bi-214 609.31
2	660.21 665.47 0.0000 0.0000	53	7	12	661.63	0.47	1.05	Cs-137 661.66
3	724.23 729.94 0.0000 0.0000	50	-9	14	728.18	1.43	1.62	Bi-212 727.00
4	766.11 772.03 0.0000 0.0001	55	-1	14	769.84	0.22	0.35	Bi-214 768.36
5	823.77 829.47 0.0000 0.0295	44	-6	12	825.97	0.22	0.35	Co-60 826.28
6	844.60 850.30 0.0000 0.0000	85	49	13	847.82	0.60	1.60	Co-56 846.77
7	857.32 863.02 0.0000 0.0000	46	1	12	860.61	1.21	1.40	Tl-208 860.56
8	908.62 914.32 0.0000 0.0000	50	32	9	912.34	0.24	0.38	Ac-228 911.20
9	965.83 971.97 0.0000 0.0000	27	12	8	967.59	2.85	2.98	Ac-228 968.97
10	998.71 1004.85 0.0003 0.0003	50	11	12	1001.22	0.48	0.94	Pa-234M 1001.03
11	1060.09 1066.23 match!	27	12	8	1060.75	0.22	0.35	No close library
12	1118.17 1124.31 0.0000 0.0000	46	12	11	1121.78	0.41	0.56	Bi-214 1120.29
13	1170.34 1176.48	28	-30	13	Could not properly fit the peak.			
14	1233.24 1241.13 0.0000 0.0000	63	-17	19	1239.16	0.44	0.92	Co-56 1238.28
15	1270.72 1277.29	20	-1	9	Could not properly fit the peak.			
16	1329.88 1336.46	16	-10	9	Could not properly fit the peak.			
17	1457.64 1464.65 0.0002 0.0000	74	63	10	1461.66	0.64	2.38	K-40 1461.00
18	1762.38 1769.83 0.0001 0.0000	53	30	11	1765.13	1.33	1.68	Bi-214 1764.49

MB-11066.Rpt

Detector #1 ACQ 19-Nov-2015 at 15:10:18 RT = 7207.5 LT = 7200.0
 Rad Chem 1
 MB-323

ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
1	607.80 612.63 0.0000 0.0000	152	87	16	609.95	1.22	1.86	Bi-214 609.31
2	660.21 665.47 0.0000 0.0000	64	-11	15	661.74	0.33	0.75	Cs-137 661.66
3	724.23 729.94 0.0000 0.0000	45	13	11	725.99	0.88	1.01	Bi-212 727.00
4	766.11 772.03 0.0000 0.0001	61	0	14	768.96	0.29	1.62	Bi-214 768.36
5	823.77 829.47 0.0000 0.0295	45	0	12	824.98	4.03	4.46	Co-60 826.28
6	844.60 850.30 0.0000 0.0000	95	45	14	848.31	0.25	0.41	Co-56 846.77
7	857.32 863.02 0.0000 0.0000	32	9	9	859.91	0.32	0.52	Tl-208 860.56
8	908.62 914.32 0.0000 0.0000	49	22	10	911.69	1.70	1.86	Ac-228 911.20
9	965.83 971.97 0.0000 0.0000	45	-3	13	968.90	0.27	0.70	Ac-228 968.97
10	998.71 1004.85 0.0000 0.0003	36	-8	12	1001.13	0.33	0.53	Pa-234M 1001.03
11	1060.09 1066.23 match!	24	-5	10	1063.16	0.22	0.35	No close library
12	1118.17 1124.31 0.0000 0.0000	64	20	13	1120.59	0.37	1.21	Bi-214 1120.29
13	1170.34 1176.48 0.0000 0.0000	29	0	10	1171.43	0.33	0.53	Co-60 1173.24
14	1233.24 1241.13 0.0001 0.0001	42	11	13	1234.12	6.47	6.66	Bi-214 1238.11
15	1270.72 1277.29 match!	36	5	11	1274.44	0.33	0.53	No close library
16	1329.88 1336.46 0.0000 0.0000	23	18	6	1334.49	0.22	0.35	Co-60 1332.50
17	1457.64 1464.65 0.0002 0.0000	64	47	11	1461.66	1.14	2.59	K-40 1461.00
18	1762.38 1769.83 0.0001 0.0000	41	35	7	1765.42	0.29	0.95	Bi-214 1764.49

MB-11089.Rpt

Detector #1 ACQ 27-Nov-2015 at 21:11:20 RT = 7206.8 LT = 7200.0
 Rad Chem 1
 MB-331

ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
1	607.80 612.63 0.0000 0.0000	129	79	14	609.88	0.95	1.38	Bi-214 609.31
2	660.21 665.47 0.0000 0.0000	63	-12	15	Could not properly fit the peak.			
3	724.23 729.94 0.0000 0.0000	54	-9	14	728.40	0.33	0.53	Bi-212 727.00
4	766.11 772.03 0.0000 0.0001	66	10	14	769.62	0.26	0.44	Bi-214 768.36
5	823.77 829.47 0.0049 0.0295	43	2	12	825.75	0.22	0.35	Co-60 826.28
6	844.60 850.30 0.0000 0.0000	76	49	11	847.44	0.36	2.22	Co-56 846.77
7	857.32 863.02 0.0000 0.0000	48	3	12	859.29	0.22	0.35	Tl-208 860.56
8	908.62 914.32 0.0000 0.0000	56	24	11	912.32	0.27	1.14	Ac-228 911.20
9	965.83 971.97 0.0000 0.0000	44	15	11	969.34	0.25	0.39	Ac-228 968.97
10	998.71 1004.85 0.0004 0.0003	40	16	10	999.37	4.60	4.73	Pa-234M1001.03
11	1060.09 1066.23 match!	29	10	9	1064.47	0.22	0.35	No close library
12	1118.17 1124.31 0.0000 0.0000	58	24	12	1121.20	1.37	1.72	Bi-214 1120.29
13	1170.34 1176.48 0.0000 0.0000	18	-1	8	1174.50	0.33	0.53	Co-60 1173.24
14	1233.24 1241.13 0.0000 0.0000	39	8	12	1238.50	0.22	0.35	Co-56 1238.28
15	1270.72 1277.29 match!	28	2	10	1275.76	0.22	0.35	No close library
16	1329.88 1336.46 0.0000 0.0000	25	20	6	1330.54	5.37	5.57	Co-60 1332.50
17	1457.64 1464.65 0.0001 0.0000	47	30	10	1462.68	0.33	1.82	K-40 1461.00
18	1762.38 1769.83 0.0001 0.0000	43	20	11	1765.45	0.82	1.24	Bi-214 1764.49

MB-11117.Rpt

Detector #1	ACQ	02-Dec-2015 at 19:18:00	RT = 7207.4	LT = 7200.0
Rad	Chem	1		
MB-336				
ROI#	RANGE(keV)	GROSS	NET	+/-
	μ Ci +/-			
1	607.80 612.63 0.0000 0.0000	130	69	15
2	660.21 665.47 0.0000 0.0000	64	6	13
3	724.23 729.94 0.0000 0.0000	58	4	13
4	766.11 772.03 0.0001 0.0000	57	20	12
5	823.77 829.47 0.0000 0.0345	47	-16	14
6	844.60 850.30 0.0000 0.0000	97	61	13
7	857.32 863.02 0.0000 0.0000	46	10	11
8	908.62 914.32 0.0000 0.0000	53	-1	13
9	965.83 971.97 0.0000 0.0000	42	13	11
10	998.71 1004.85 0.0000 0.0003	36	-3	12
11	1060.09 1066.23 match!	27	-7	11
12	1118.17 1124.31 0.0001 0.0000	52	37	9
13	1170.34 1176.48 0.0000 0.0000	26	-13	11
14	1233.24 1241.13 0.0000 0.0000	50	31	11
15	1270.72 1277.29 match!	33	2	11
16	1329.88 1336.46	22	-25	13
17	1457.64 1464.65 0.0001 0.0000	72	33	14
18	1762.38 1769.83 0.0001 0.0000	43	37	8

MB-11169.Rpt

Detector #1 ACQ 15-Dec-2015 at 10:28:51 RT = 7208.2 LT = 7200.0
 Rad Chem 1
 MB-336

ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
1	607.80 612.63 0.0000 0.0000	132	74	15	609.75	0.73	2.20	Bi-214 609.31
2	660.21 665.47 0.0000 0.0000	62	-5	14	663.72	0.22	0.35	Cs-137 661.66
3	724.23 729.94 0.0000 0.0000	48	-11	13	727.96	0.22	0.35	Bi-212 727.00
4	766.11 772.03 0.0001 0.0001	74	18	14	767.87	0.66	0.79	Bi-214 768.36
5	823.77 829.47 0.0000 0.0320	44	-15	13	826.62	0.22	0.35	Co-60 826.28
6	844.60 850.30 0.0000 0.0000	99	54	14	847.64	1.32	2.02	Co-56 846.77
7	857.32 863.02 0.0000 0.0000	43	2	12	858.41	1.75	1.89	Tl-208 860.56
8	908.62 914.32 0.0000 0.0000	52	29	10	912.05	0.42	0.63	Ac-228 911.20
9	965.83 971.97 0.0000 0.0000	36	-3	12	968.68	0.27	0.99	Ac-228 968.97
10	998.71 1004.85 0.0007 0.0002	40	25	9	1003.72	0.35	1.39	Pa-234M 1001.03
11	1060.09 1066.23 match!	21	-3	9	1060.75	0.22	0.35	No close library
12	1118.17 1124.31 0.0000 0.0000	55	21	12	1120.75	0.47	2.15	Bi-214 1120.29
13	1170.34 1176.48 0.0000 0.0000	28	-6	11	1172.75	0.22	0.35	Co-60 1173.24
14	1233.24 1241.13 0.0000 0.0000	39	39	6	1239.32	0.55	1.96	Co-56 1238.28
15	1270.72 1277.29 match!	28	-13	12	1272.25	0.33	0.53	No close library
16	1329.88 1336.46	17	-4	9	Could not properly fit the peak.			
17	1457.64 1464.65 0.0001 0.0000	66	38	12	1462.04	0.48	1.20	K-40 1461.00
18	1762.38 1769.83 0.0001 0.0000	41	35	7	1766.28	0.33	0.85	Bi-214 1764.49

MB-11303.Rpt

Detector #1 ACQ 18-Jan-2016 at 16:35:25 RT = 7210.3 LT = 7200.0
 Rad Chem 1
 MB-018

ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
1	607.80 612.63 0.0000 0.0000	141	76	16	609.85	0.52	1.47	Bi-214 609.31
2	660.21 665.47 0.0000 0.0000	59	9	12	662.18	0.22	0.35	Cs-137 661.66
3	724.23 729.94 0.0000 0.0000	60	1	14	725.11	3.29	3.42	Bi-212 727.00
4	766.11 772.03 0.0000 0.0000	51	4	13	766.77	0.22	0.35	Bi-214 768.36
5	823.77 829.47 0.0049 0.0295	47	2	12	828.63	0.29	0.50	Co-60 826.28
6	844.60 850.30 0.0000 0.0000	102	43	15	847.53	0.52	1.77	Co-56 846.77
7	857.32 863.02 0.0000 0.0000	34	-7	11	861.04	0.26	0.44	Tl-208 860.56
8	908.62 914.32 0.0000 0.0000	70	20	13	912.23	0.92	1.64	Ac-228 911.20
9	965.83 971.97 0.0000 0.0000	41	2	12	969.56	0.22	0.35	Ac-228 968.97
10	998.71 1004.85 0.0010 0.0002	41	36	7	1000.80	0.39	0.55	Pa-234M 1001.03
11	1060.09 1066.23 match!	31	21	7	1063.12	0.35	1.83	No close library
12	1118.17 1124.31 0.0000 0.0000	53	24	11	1120.69	0.40	0.61	Bi-214 1120.29
13	1170.34 1176.48 0.0000 0.0000	34	15	9	1174.72	0.22	0.35	Co-60 1173.24
14	1233.24 1241.13 0.0000 0.0000	40	3	13	1238.54	0.32	1.31	Co-56 1238.28
15	1270.72 1277.29 match!	20	15	6	1276.06	0.87	1.00	No close library
16	1329.88 1336.46 0.0000 0.0000	19	14	5	1335.58	0.27	0.48	Co-60 1332.50
17	1457.64 1464.65 0.0001 0.0000	60	38	11	1461.14	0.25	0.40	K-40 1461.00
18	1762.38 1769.83 0.0001 0.0000	54	25	12	1765.35	1.63	1.84	Bi-214 1764.49

MB-11304.Rpt

Detector #1 ACQ 19-Jan-2016 at 16:25:39 RT = 7210.2 LT = 7200.0
 Rad Chem 1
 MB-019

ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
1	607.80 612.63 0.0000 0.0000	163	105	16	609.63	1.02	1.77	Bi-214 609.31
2	660.21 665.47 0.0000 0.0000	67	9	13	663.75	0.31	0.54	Cs-137 661.66
3	724.23 729.94 0.0000 0.0000	42	19	9	727.82	0.89	2.02	Bi-212 727.00
4	766.11 772.03 0.0001 0.0000	65	18	13	768.30	0.26	0.44	Bi-214 768.36
5	823.77 829.47 0.0000 0.0295	45	0	12	824.43	2.19	2.32	Co-60 826.28
6	844.60 850.30 0.0000 0.0000	101	42	15	847.01	0.95	1.59	Co-56 846.77
7	857.32 863.02 0.0000 0.0000	47	2	12	859.29	0.22	0.35	Tl-208 860.56
8	908.62 914.32 0.0000 0.0000	58	17	12	912.56	0.25	0.39	Ac-228 911.20
9	965.83 971.97 0.0000 0.0000	44	-14	14	966.49	0.22	0.35	Ac-228 968.97
10	998.71 1004.85 0.0002 0.0003	38	9	10	1003.54	0.26	0.44	Pa-234M 1001.03
11	1060.09 1066.23	30	-14	12	Could not properly fit the peak.			
12	1118.17 1124.31 0.0000 0.0000	54	15	12	1120.89	0.45	0.99	Bi-214 1120.29
13	1170.34 1176.48 0.0000 0.0000	30	-4	11	1171.00	0.88	1.01	Co-60 1173.24
14	1233.24 1241.13 0.0001 0.0001	45	26	11	1234.12	5.37	5.65	Bi-214 1238.11
15	1270.72 1277.29 match!	37	6	11	1273.24	0.43	0.65	No close library
16	1329.88 1336.46 0.0000 0.0000	27	-4	11	1330.98	4.82	4.95	Co-60 1332.50
17	1457.64 1464.65 0.0002 0.0000	71	54	11	1461.97	0.88	1.75	K-40 1461.00
18	1762.38 1769.83 0.0001 0.0000	38	38	6	1765.67	1.17	1.62	Bi-214 1764.49

MB-11319.Rpt

Detector #1 ACQ 22-Jan-2016 at 15:59:31 RT = 7209.2 LT = 7200.0
 Rad Chem 1
 MB-022

ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
1	607.80 612.63 0.0000 0.0000	162	85	17	609.81	1.20	1.97	Bi-214 609.31
2	660.21 665.47 0.0000 0.0000	48	6	11	664.37	0.26	0.44	Cs-137 661.66
3	724.23 729.94 0.0000 0.0000	52	20	11	726.74	1.82	3.34	Bi-212 727.00
4	766.11 772.03 0.0000 0.0001	60	-1	14	768.63	0.80	0.98	Bi-214 768.36
5	823.77 829.47 0.0345 0.0271	46	14	11	826.66	0.32	0.74	Co-60 826.28
6	844.60 850.30 0.0000 0.0000	85	49	13	847.59	0.46	0.75	Co-56 846.77
7	857.32 863.02 0.0000 0.0000	48	-11	13	860.17	0.22	0.35	Tl-208 860.56
8	908.62 914.32 0.0000 0.0000	50	5	12	911.47	0.25	0.39	Ac-228 911.20
9	965.83 971.97 0.0000 0.0000	41	-3	12	969.88	0.39	0.55	Ac-228 968.97
10	998.71 1004.85 0.0003 0.0003	40	11	11	1002.12	0.41	0.56	Pa-234M 1001.03
11	1060.09 1066.23 match!	21	11	6	1060.75	1.42	1.62	No close library
12	1118.17 1124.31 0.0001 0.0000	59	59	7	1121.33	0.79	1.78	Bi-214 1120.29
13	1170.34 1176.48 0.0000 0.0000	23	8	8	1171.00	0.26	0.96	Co-60 1173.24
14	1233.24 1241.13 0.0001 0.0000	36	17	10	1235.43	1.75	1.88	Bi-214 1238.11
15	1270.72 1277.29 match!	21	5	8	1271.37	2.63	2.76	No close library
16	1329.88 1336.46	23	-3	10	Could not properly fit the peak.			
17	1457.64 1464.65 0.0002 0.0000	70	64	9	1461.08	1.84	3.60	K-40 1461.00
18	1762.38 1769.83 0.0001 0.0000	42	24	10	1765.08	1.00	1.19	Bi-214 1764.49

MB-11381.Rpt

Detector #1 ACQ 09-Feb-2016 at 13:22:38 RT = 7210.0 LT = 7200.0
 Rad Chem 1
 MB-11372

ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
1	607.80 612.63 0.0000 0.0000	145	45	18	609.89	0.65	0.96	Bi-214 609.31
2	660.21 665.47 0.0000 0.0000	56	6	12	661.20	0.84	1.00	Cs-137 661.66
3	724.23 729.94 0.0001 0.0000	59	27	11	727.55	0.29	0.50	Bi-212 727.00
4	766.11 772.03 0.0001 0.0001	68	17	14	768.78	0.35	0.83	Bi-214 768.36
5	823.77 829.47 0.0000 0.0320	48	-11	13	824.87	0.22	0.35	Co-60 826.28
6	844.60 850.30 0.0000 0.0000	90	40	14	847.45	0.40	0.93	Co-56 846.77
7	857.32 863.02 0.0000 0.0000	36	9	10	858.19	0.27	0.48	Tl-208 860.56
8	908.62 914.32 0.0000 0.0000	56	24	11	911.58	0.91	2.34	Ac-228 911.20
9	965.83 971.97 0.0000 0.0000	36	17	9	970.54	0.42	1.49	Ac-228 968.97
10	998.71 1004.85 0.0003 0.0003	40	11	11	999.37	0.22	0.35	Pa-234M 1001.03
11	1060.09 1066.23 match!	29	-10	11	1061.19	0.33	0.53	No close library
12	1118.17 1124.31 0.0000 0.0000	48	0	13	1120.37	1.37	1.58	Bi-214 1120.29
13	1170.34 1176.48	19	0	8	Could not properly fit the peak.			
14	1233.24 1241.13 0.0000 0.0000	36	-7	14	1239.48	0.41	0.56	Co-56 1238.28
15	1270.72 1277.29	19	-7	10	Could not properly fit the peak.			
16	1329.88 1336.46 0.0000 0.0000	23	-8	11	1335.80	0.22	0.35	Co-60 1332.50
17	1457.64 1464.65 0.0001 0.0000	55	38	10	1461.97	0.44	1.23	K-40 1461.00
18	1762.38 1769.83 0.0001 0.0000	42	30	9	1766.33	0.24	0.39	Bi-214 1764.49

MB-11412.Rpt

Detector #1 Rad MB-11412	ACQ Chem 1	18-Feb-2016 at 8:43:01	RT = 7207.5	LT = 7200.0				
ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
1	607.80 612.63 0.0000 0.0000	136	67	16	609.35	0.38	1.48	Bi-214 609.31
2	660.21 665.47 0.0000 0.0000	55	17	11	663.16	0.39	0.55	Cs-137 661.66
3	724.23 729.94	56	-25	16	Could not properly fit the peak.			
4	766.11 772.03 0.0000 0.0001	63	-2	15	770.28	0.22	0.35	Bi-214 768.36
5	823.77 829.47 0.0123 0.0295	50	5	12	825.53	2.96	3.16	Co-60 826.28
6	844.60 850.30 0.0000 0.0000	104	63	14	847.31	0.51	1.32	Co-56 846.77
7	857.32 863.02 0.0000 0.0000	49	4	12	858.19	0.27	0.48	Tl-208 860.56
8	908.62 914.32 0.0000 0.0000	63	-5	15	910.15	1.75	1.89	Ac-228 911.20
9	965.83 971.97 0.0000 0.0000	40	16	10	968.90	0.26	0.66	Ac-228 968.97
10	998.71 1004.85 0.0000 0.0004	46	-7	14	1002.88	0.22	0.35	Pa-234M 1001.03
11	1060.09 1066.23 match!	27	8	9	1063.60	0.22	0.35	No close library
12	1118.17 1124.31 0.0000 0.0000	60	26	12	1120.63	0.31	0.99	Bi-214 1120.29
13	1170.34 1176.48 0.0000 0.0000	32	27	6	1172.97	0.24	0.39	Co-60 1173.24
14	1233.24 1241.13 0.0001 0.0001	48	11	14	1233.90	6.79	6.93	Bi-214 1238.11
15	1270.72 1277.29 match!	28	18	7	1274.00	2.47	2.67	No close library
16	1329.88 1336.46	26	-15	12	Could not properly fit the peak.			
17	1457.64 1464.65 0.0002 0.0000	82	60	12	1461.35	0.92	1.18	K-40 1461.00
18	1762.38 1769.83 0.0001 0.0000	44	26	10	1766.11	0.27	1.10	Bi-214 1764.49

MB-11466.Rpt

Detector #1 ACQ 01-Mar-2016 at 16:12:34 RT = 7208.6 LT = 7200.0
 Rad Chem 1
 MB-061

ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
1	607.80 612.63 0.0000 0.0000	117	44	15	609.57	0.40	1.41	Bi-214 609.31
2	660.21 665.47 0.0000 0.0000	64	22	12	664.37	0.25	0.39	Cs-137 661.66
3	724.23 729.94 0.0000 0.0000	56	-7	14	727.74	0.22	0.35	Bi-212 727.00
4	766.11 772.03 0.0000 0.0000	47	-4	13	769.18	2.30	2.50	Bi-214 768.36
5	823.77 829.47 0.0000 0.0271	33	-8	11	824.43	1.97	2.10	Co-60 826.28
6	844.60 850.30 0.0000 0.0000	92	47	14	846.54	0.27	0.65	Co-56 846.77
7	857.32 863.02	42	-21	14	Could not properly fit the peak.			
8	908.62 914.32 0.0000 0.0000	46	-8	13	911.69	0.27	0.48	Ac-228 911.20
9	965.83 971.97 0.0000 0.0000	38	-1	12	970.00	0.22	0.35	Ac-228 968.97
10	998.71 1004.85 0.0000 0.0004	47	-16	15	1003.20	0.40	0.55	Pa-234M1001.03
11	1060.09 1066.23 match!	34	-10	12	1065.13	0.33	0.53	No close library
12	1118.17 1124.31 0.0000 0.0000	55	21	12	1120.67	0.48	1.05	Bi-214 1120.29
13	1170.34 1176.48 0.0000 0.0000	30	1	10	1173.63	1.10	1.23	Co-60 1173.24
14	1233.24 1241.13 0.0001 0.0000	41	29	9	1238.06	0.29	3.93	Bi-214 1238.11
15	1270.72 1277.29 match!	28	2	10	1271.81	0.22	0.35	No close library
16	1329.88 1336.46	20	-11	10	Could not properly fit the peak.			
17	1457.64 1464.65 0.0001 0.0000	44	33	9	1462.07	0.46	1.66	K-40 1461.00
18	1762.38 1769.83 0.0001 0.0000	44	26	10	1765.53	0.51	0.96	Bi-214 1764.49

MB-11523.Rpt

Detector #1 ACQ 15-Mar-2016 at 16:23:17 RT = 7208.7 LT = 7200.0
 Rad Chem 1
 MB-075

ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
1	607.80 612.63 0.0000 0.0000	118	49	15	609.08	0.53	1.71	Bi-214 609.31
2	660.21 665.47 0.0000 0.0000	59	-4	13	661.96	0.26	0.44	Cs-137 661.66
3	724.23 729.94 0.0000 0.0000	61	11	13	728.58	0.32	0.74	Bi-212 727.00
4	766.11 772.03 0.0001 0.0000	56	23	11	768.30	0.25	0.39	Bi-214 768.36
5	823.77 829.47	42	-21	14	Could not properly fit the peak.			
6	844.60 850.30 0.0000 0.0000	99	81	12	847.54	0.59	1.74	Co-56 846.77
7	857.32 863.02	39	-15	13	Could not properly fit the peak.			
8	908.62 914.32 0.0000 0.0000	48	25	10	911.23	0.69	1.47	Ac-228 911.20
9	965.83 971.97 0.0000 0.0000	50	2	13	969.56	0.22	0.35	Ac-228 968.97
10	998.71 1004.85 0.0004 0.0003	39	15	10	1003.64	0.88	1.14	Pa-234M 1001.03
11	1060.09 1066.23 match!	30	11	9	1062.72	0.22	0.35	No close library
12	1118.17 1124.31 0.0000 0.0000	57	23	12	1120.15	1.83	2.05	Bi-214 1120.29
13	1170.34 1176.48 0.0000 0.0000	34	15	9	1173.63	1.32	1.45	Co-60 1173.24
14	1233.24 1241.13 0.0000 0.0000	51	20	13	1238.72	0.22	0.35	Co-56 1238.28
15	1270.72 1277.29 match!	23	13	7	1271.59	3.84	4.03	No close library
16	1329.88 1336.46	22	-9	10	Could not properly fit the peak.			
17	1457.64 1464.65 0.0002 0.0000	55	49	8	1461.20	1.03	2.37	K-40 1461.00
18	1762.38 1769.83 0.0001 0.0000	38	32	7	1764.87	0.93	1.98	Bi-214 1764.49

MB-11552.Rpt

Detector #1	ACQ	26-Mar-2016 at 18:57:32	RT =	7207.5	LT =	7200.0		
Rad	Chem	1						
MB-086								
ROI#	RANGE(keV)	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
μCi	+/-							
1	607.80 612.63 0.0000 0.0000	128	17	18	609.78	0.51	0.76	Bi-214 609.31
2	660.21 665.47 0.0000 0.0000	60	14	12	661.96	0.22	0.35	Cs-137 661.66
3	724.23 729.94 0.0000 0.0000	43	-7	12	725.33	2.19	2.32	Bi-212 727.00
4	766.11 772.03 0.0001 0.0000	57	15	13	766.99	0.88	1.01	Bi-214 768.36
5	823.77 829.47 0.0123 0.0271	41	5	11	825.97	0.27	0.70	Co-60 826.28
6	844.60 850.30 0.0000 0.0000	101	60	14	847.31	0.48	1.42	Co-56 846.77
7	857.32 863.02	34	-16	12	Could not properly fit the peak.			
8	908.62 914.32 0.0000 0.0000	54	9	12	909.49	1.97	2.10	Ac-228 911.20
9	965.83 971.97 0.0000 0.0000	45	21	10	969.12	0.88	1.01	Ac-228 968.97
10	998.71 1004.85 0.0003 0.0002	30	11	9	1003.10	0.27	0.48	Pa-234M 1001.03
11	1060.09 1066.23 match!	24	-10	10	1062.94	0.22	0.35	No close library
12	1118.17 1124.31 0.0000 0.0000	55	26	11	1120.75	0.78	1.47	Bi-214 1120.29
13	1170.34 1176.48	22	3	8	Could not properly fit the peak.			
14	1233.24 1241.13 0.0000 0.0000	39	8	12	1239.16	0.27	0.77	Co-56 1238.28
15	1270.72 1277.29 match!	30	-6	12	1275.10	0.22	0.35	No close library
16	1329.88 1336.46 0.0000 0.0000	25	-1	10	1335.58	0.27	0.48	Co-60 1332.50
17	1457.64 1464.65 0.0001 0.0000	65	43	11	1461.16	0.34	1.58	K-40 1461.00
18	1762.38 1769.83 0.0001 0.0000	41	23	10	1765.56	1.03	1.85	Bi-214 1764.49

MB-11595.Rpt

Detector #1 ACQ 07-Apr-2016 at 11:52:35 RT = 7210.1 LT = 7200.0
 Rad Chem 1
 MB-098

ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
1	607.80 612.63 0.0000 0.0000	114	45	15	610.01	0.36	1.72	Bi-214 609.31
2	660.21 665.47 0.0000 0.0000	70	3	14	661.33	0.29	0.61	Cs-137 661.66
3	724.23 729.94 0.0000 0.0000	57	16	12	727.18	2.11	2.89	Bi-212 727.00
4	766.11 772.03 0.0000 0.0000	55	8	13	768.09	0.26	0.75	Bi-214 768.36
5	823.77 829.47	39	-11	12	Could not properly fit the peak.			
6	844.60 850.30 0.0000 0.0000	74	56	10	847.26	0.35	1.46	Co-56 846.77
7	857.32 863.02 0.0000 0.0000	44	17	10	859.61	2.66	2.89	Tl-208 860.56
8	908.62 914.32 0.0000 0.0000	45	4	12	911.47	0.29	1.27	Ac-228 911.20
9	965.83 971.97 0.0000 0.0000	44	-9	13	969.56	0.22	0.35	Ac-228 968.97
10	998.71 1004.85 0.0000 0.0003	41	-3	12	1000.25	0.22	0.35	Pa-234M 1001.03
11	1060.09 1066.23 match!	40	-8	13	1061.19	1.10	1.23	No close library
12	1118.17 1124.31 0.0000 0.0000	67	23	13	1120.59	0.91	2.41	Bi-214 1120.29
13	1170.34 1176.48 0.0000 0.0000	23	4	8	1172.97	0.27	0.48	Co-60 1173.24
14	1233.24 1241.13 0.0000 0.0000	39	8	12	1238.72	1.31	1.45	Co-56 1238.28
15	1270.72 1277.29 match!	21	-15	11	1276.19	0.22	0.35	No close library
16	1329.88 1336.46 0.0000 0.0000	16	6	6	1331.20	0.27	0.48	Co-60 1332.50
17	1457.64 1464.65 0.0002 0.0000	71	54	11	1461.57	0.83	1.73	K-40 1461.00
18	1762.38 1769.83 0.0001 0.0000	43	31	9	1765.39	0.61	1.95	Bi-214 1764.49



Inter-Mountain Labs
Sheridan, WY and Gillette, WY

- CHAIN OF CUSTODY RECORD -

Page 1 of 1

All shaded fields must be completed.

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#WEB

Client Name Dawn Mining Company			Project Identification Midnite Mine		Sampler (Signature/Attestation of Authenticity) David Wright Adams					Telephone # 970 420 3750		
Report Address 8809 Washington St. NE Suite 150 Albuquerque, NM 87113			Contact Name Randy Whicker Email randywhicker@ergoffice.com		ANALYSES / PARAMETERS					REMARKS		
Invoice Address			Phone (970)-556-1174	Purchase Order #	Quote #							
ITEM	LAB ID (Lab Use Only)	DATE SAMPLED	SAMPLE IDENTIFICATION		Matrix	# of Containers	Ra-226					
1	<i>SIG07021-001</i>	06/06/16	13:20	CORR5-0015-SOI-DIS-01	SL	1	X					EPA 901.1 Modified
2	<i>002</i>	06/06/16	13:32	CORR6-0015-SOI-DIS-01	SL	1	X					EPA 901.1 Modified
3	<i>003</i>	06/06/16	13:44	CORR7-0015-SOI-DIS-01	SL	1	X					EPA 901.1 Modified
4	<i>004</i>	06/06/16	13:55	CORR8-0015-SOI-DIS-01	SL	1	X					EPA 901.1 Modified
5	<i>005</i>	06/06/16	14:19	CORR9-0015-SOI-DIS-01	SL	1	X					EPA 901.1 Modified
6	<i>006</i>	06/06/16	14:43	CORR10-0015-SOI-DIS-01	SL	1	X					EPA 901.1 Modified
7	<i>007</i>	06/06/16	15:13	CORR11-0015-SOI-DIS-01	SL	1	X					EPA 901.1 Modified
8	<i>008</i>	06/07/16	10:31	CORR12-0015-SOI-DIS-01	SL	1	X					EPA 901.1 Modified
9	<i>009</i>	06/07/16	10:43	CORR13-0015-SOI-DIS-01	SL	1	X					EPA 901.1 Modified
10	<i>010</i>	06/07/16	10:59	CORR14-0015-SOI-DIS-01	SL	1	X					EPA 901.1 Modified
11	<i>011</i>	06/07/16	11:20	CORR15-0015-SOI-DIS-01	SL	1	X					EPA 901.1 Modified
12												
13												
14												

LAB COMMENTS

Relinquished By (Signature/Printed)

DATE TIME

Received By (Signature/Printed)

DATE TIME

Custody seal

David W Adams

David W Adams

10/29/2016

9:55

Kathy Boyd

7.5.16

955

23.2

SHIPPING INFO		MATRIX CODES		TURN AROUND TIMES		COMPLIANCE INFORMATION			ADDITIONAL REMARKS	
<input type="checkbox"/> UPS	Water	WT	Check desired service		Compliance Monitoring ?			Y / N	Must meet detection limit of <1.0 pCi/g	
<input type="checkbox"/> FedEx	Soil	SL	<input checked="" type="checkbox"/> Standard turnaround		Program (SDWA, NPDES,...)				Count in can use mass (grams) recorded on can	
<input type="checkbox"/> USPS	Solid	SD	<input type="checkbox"/> RUSH - 5 Working Days		PWSID / Permit #				Level IV Reporting REQUIRED	
<input type="checkbox"/> Hand Carried	Filter	FT	<input type="checkbox"/> URGENT - < 2 Working Days		Chlorinated?			Y / N	Deliver Preliminary EDD ASAP	
<input type="checkbox"/> Other	Other	OT	Rush & Urgent Surcharges will be applied		Sample Disposal: Lab			Client	Ensure >21 days has passed since "Date Sealed"	

CORR5-0015-SOI-COM-01
Collected: 6/6/16
Sealed: 6/7/16
148.61g

CORR6-0015-SOI-COM-01
Collected: 6/6/2016
Sealed: 6/7/2016
187.91g

CORR7-0015-SOI-COM-01
Collected 6-6-16
Sealed 6-8-16
179.24g

Corr 8-0015-SOI-COM-01
Collected 6/6
Sealed 6/8
KoO. 82grams

CORR9-0015-SOI-COM-01
Collected 6-6-16
Sealed 6-8-16
175.46 grams

Corr 10-0015-SOI-COM-01
Collected 6/6
Sealed 6/8
128.78gmm

Corr 11-0015-SOI-COM-01
Collected 6/6
Sealed 6/8
186.16 grams

Corr 12-0015-SOI-COM-01
Collected 6/7
Sealed 6/8
181.41 grams

Corr 13-0015-SOI-COM-01
Collected 6/7
Sealed 6/8
176.03 grams

Corr 14-0015-SOI-COM-01
Collected 6/7/16
Sealed 6/8/16
183.92 g

CORR15-0015-SOI-COM-01
Collected 6-7-16
Sealed 6-8-16
179.56 grams



Report Review Checklist

COC Review Information on COC matches that on report; spelling accurate.

- 1 Original COC attached, signed and dated.
- 2 Parameters requested.
- 3 Client.
- 4 Report recipient/address.
- 5 Invoice recipient/address.
- 6 Project.
- 7 Appropriate PQLs selected.
- 8 Prices may need to be adjusted prior to invoicing.
- 9 P. O. number.
- 10 Sample IDs.
- 11 Sample dates.
- 12 Date received.
- 13 Date due.
- 14 Matrix.
- 15 PWSID included for safe drinking water compliance samples.
- 16 Field data entered appropriately, matches lab data.
- 17 Special requests indicated in "Comments" section of Work Order summary.

	Log Review	Report Review
1 Original COC attached, signed and dated.	✓	✓
2 Parameters requested.	✓	✓
3 Client.	✓	✓
4 Report recipient/address.	✓	✓
5 Invoice recipient/address.	✓	✓
6 Project.	✓	✓
7 Appropriate PQLs selected.	✓	✓
8 Prices may need to be adjusted prior to invoicing.	Yes or No	
9 P. O. number.	—	NA
10 Sample IDs.	✓	✓
11 Sample dates.	✓	✓
12 Date received.	✓	✓
13 Date due.	✓	✓
14 Matrix.	✓	✓
15 PWSID included for safe drinking water compliance samples.	—	NA
16 Field data entered appropriately, matches lab data.	—	NA
17 Special requests indicated in "Comments" section of Work Order summary.	—	ND

Data Review

- 1 Automated QC (Check Data button) review performed, discrepancies resolved.
- 2 Worksheet/instrument data sheet for all requested parameters attached to data packet.
- 3 Worksheet/instrument data sheet initialed and dated by analyst, indicating review.
- 4 Worksheet/instrument data compared to report results for calculation, transcription and data entry errors.
- 5 Analysis date and time.
- 6 Analytical method.
- 7 Appropriate units of measure.
- 8 Analyst's initials.
- 9 Calculations checked?
- 10 Subcontracted analyses identified as such with qualifier.
- 11 Invoice parameters match those on COC.

Final Review

- 1 Report appears complete and appropriate.
- 2 Condition Upon Receipt form completed, attached to packet, and related qualifiers included in report.
- 3 All necessary qualifiers included in report.
- 4 Qualifiers referenced in case narrative; which includes descriptions of all sample/analysis anomalies.
- 5 Anomalies explained in Case Narrative.
- 6 Copies of report sent to all recipients requested on COC. Hard copies. Emailed copies.
- 7 All special requests listed on COC honored.
- 8 Special report format per client request.
- 9 Report pages signed.



Inter-Mountain Labs

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Date: 7/20/2016

CLIENT: Dawn Mining Company
Project: Midnite Mine
Lab Order: S1607240

CASE NARRATIVE

Report ID: S1607240001

This report contains:

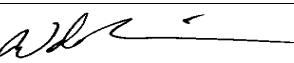
Case Narrative - 1 page
Sample Analysis Report - 9 pages
Analytical QC Summary Report - 1 page
Gamma Spec LIMS Report and Export File - 2 pages
Gamma Spec Ra 226 Spectrum and ROI Data - 32 pages
Gamma Spec Ra 226 Standards Certificates - 17 pages
Gamma Spec Ra 226 ROI Calibration and Blanks - 18 pages
Original COC, Condition Upon Receipt and Supporting Documentation - 5 page

Samples CORR16-0015-SOI-DIS-01, CORR17-0015-SOI-DIS-01, CORR18-0015-SOI-DIS-01, CORR19-0015-SOI-DIS-01, CORR20-0015-SOI-DIS-01, CORR21-0015-SOI-DIS-01, CORR22-0015-SOI-DIS-01, CORR23-0015-SOI-DIS-01, and CORR24-0015-SOI-DIS-01 were received on July 18, 2016. .

All samples were received and analyzed within the EPA recommended holding times, except those noted below in this case narrative. Samples were analyzed using the methods outlined in the following references:

U.S.E.P.A. 600 "Methods for Chemical Analysis of Water and Wastes", 1993
"Standard Methods For The Examination of Water and Wastewater", 20th ed., 1998
Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, 3rd Edition
Methods indicated with the Monday, March 12, 2007 Federal Register, 40 CFR Part 122, 136 et al.
US EPA Methods from Technology Transfer Network Ambient Monitoring Technology Information Center, 2009

All Quality objectives were achieved except as noted below:

Reviewed by: 

Wade Nieuwsma, Assistant Laboratory Manager

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Inter-Mountain Labs

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Sample Analysis Report

Company:	Dawn Mining Company 8809 Washington St. NE Suite 150 Albuquerque, NM 87113	Date Reported	7/20/2016
		Report ID	S1607240001
ProjectName:	Midnite Mine	WorkOrder:	S1607240
Lab ID:	S1607240-001	CollectionDate:	6/13/2016 9:44:00 AM
ClientSample ID:	CORR16-0015-SOI-DIS-01	DateReceived:	7/18/2016 10:15:00 AM
COC:	WEB	FieldSampler:	DA
		Matrix:	Solid

Comments

Analyses	Result	Units	Qual	RL	Method	Date Analyzed/Init
----------	--------	-------	------	----	--------	--------------------

Radionuclides - Total

Radium 226	1.1	pCi/g	0.4	E901.1 Mod.	07/18/2016 1433	MB
Radium 226 Precision (\pm)	0.2	pCi/g		E901.1 Mod.	07/18/2016 1433	MB

These results apply only to the samples tested.**RL - Reporting Limit**

Qualifiers:

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL or is less than LCL
O	Outside the Range of Dilutions
X	Matrix Effect

C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by another laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

Reviewed by: Wade Nieuwsma

Wade Nieuwsma, Assistant Laboratory Manager

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Your Environmental Monitoring Partner

Sample Analysis Report

Company:	Dawn Mining Company 8809 Washington St. NE Suite 150 Albuquerque, NM 87113	Date Reported	7/20/2016
		Report ID	S1607240001
ProjectName:	Midnite Mine	WorkOrder:	S1607240
Lab ID:	S1607240-002	CollectionDate:	6/13/2016 10:18:00 AM
ClientSample ID:	CORR17-0015-SOI-DIS-01	DateReceived:	7/18/2016 10:15:00 AM
COC:	WEB	FieldSampler:	DA
		Matrix:	Solid

Comments

Analyses	Result	Units	Qual	RL	Method	Date Analyzed/Init	
Radionuclides - Total							
Radium 226	1.4	pCi/g		0.4	E901.1 Mod.	07/18/2016 1550	MB
Radium 226 Precision (\pm)	0.2	pCi/g			E901.1 Mod.	07/18/2016 1550	MB

These results apply only to the samples tested.**RL - Reporting Limit**

Qualifiers:	B Analyte detected in the associated Method Blank	C Calculated Value
E Value above quantitation range	H Holding times for preparation or analysis exceeded	
J Analyte detected below quantitation limits	L Analyzed by another laboratory	
M Value exceeds Monthly Ave or MCL or is less than LCL	ND Not Detected at the Reporting Limit	
O Outside the Range of Dilutions	S Spike Recovery outside accepted recovery limits	
X Matrix Effect		

Reviewed by: A. Nieuwsma

Wade Nieuwsma, Assistant Laboratory Manager

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1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Sample Analysis Report

Company:	Dawn Mining Company 8809 Washington St. NE Suite 150 Albuquerque, NM 87113	Date Reported	7/20/2016
		Report ID	S1607240001
ProjectName:	Midnite Mine	WorkOrder:	S1607240
Lab ID:	S1607240-003	CollectionDate:	6/16/2016 12:03:00 PM
ClientSample ID:	CORR18-0015-SOI-DIS-01	DateReceived:	7/18/2016 10:15:00 AM
COC:	WEB	FieldSampler:	DA
		Matrix:	Solid

Comments

Analyses	Result	Units	Qual	RL	Method	Date Analyzed/Init
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Radionuclides - Total

Radium 226	11.8	pCi/g	0.4	E901.1 Mod.	07/18/2016 1718	MB
Radium 226 Precision (\pm)	0.4	pCi/g		E901.1 Mod.	07/18/2016 1718	MB

These results apply only to the samples tested.**RL - Reporting Limit**

Qualifiers:	B Analyte detected in the associated Method Blank	C Calculated Value
E Value above quantitation range	H Holding times for preparation or analysis exceeded	
J Analyte detected below quantitation limits	L Analyzed by another laboratory	
M Value exceeds Monthly Ave or MCL or is less than LCL	ND Not Detected at the Reporting Limit	
O Outside the Range of Dilutions	S Spike Recovery outside accepted recovery limits	
X Matrix Effect		

Reviewed by:

Wade Nieuwsma, Assistant Laboratory Manager

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Your Environmental Monitoring Partner

Sample Analysis Report

Company: Dawn Mining Company
8809 Washington St. NE Suite 150
Albuquerque, NM 87113 **Date Reported:** 7/20/2016
Report ID: S1607240001

ProjectName: Midnite Mine **WorkOrder:** S1607240
Lab ID: S1607240-004 **CollectionDate:** 6/16/2016 12:12:00 PM
ClientSample ID: CORR19-0015-SOI-DIS-01 **DateReceived:** 7/18/2016 10:15:00 AM
COC: WEB **FieldSampler:** DA
Matrix: Solid

Comments

Analyses	Result	Units	Qual	RL	Method	Date Analyzed/Init
Radionuclides - Total						
Radium 226	2.6	pCi/g		0.4	E901.1 Mod.	07/18/2016 1836 MB
Radium 226 Precision (\pm)	0.2	pCi/g			E901.1 Mod.	07/18/2016 1836 MB

These results apply only to the samples tested.**RL - Reporting Limit**

Qualifiers: B Analyte detected in the associated Method Blank
E Value above quantitation range
J Analyte detected below quantitation limits
M Value exceeds Monthly Ave or MCL or is less than LCL
O Outside the Range of Dilutions
X Matrix Effect

C Calculated Value
H Holding times for preparation or analysis exceeded
L Analyzed by another laboratory
ND Not Detected at the Reporting Limit
S Spike Recovery outside accepted recovery limits

Reviewed by: Wade Nieuwsma

Wade Nieuwsma, Assistant Laboratory Manager

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Sample Analysis Report

Company:	Dawn Mining Company 8809 Washington St. NE Suite 150 Albuquerque, NM 87113	Date Reported: 7/20/2016 Report ID: S1607240001
ProjectName:	Midnite Mine	WorkOrder: S1607240
Lab ID:	S1607240-005	CollectionDate: 6/16/2016 1:13:00 PM
ClientSample ID:	CORR20-0015-SOI-DIS-01	DateReceived: 7/18/2016 10:15:00 AM
COC:	WEB	FieldSampler: DA Matrix: Solid

Comments

Analyses	Result	Units	Qual	RL	Method	Date Analyzed/Init
Radionuclides - Total						
Radium 226	8.9	pCi/g		0.4	E901.1 Mod.	07/18/2016 2311 MB
Radium 226 Precision (\pm)	0.3	pCi/g			E901.1 Mod.	07/18/2016 2311 MB

These results apply only to the samples tested.**RL - Reporting Limit**

Qualifiers:	B Analyte detected in the associated Method Blank	C Calculated Value
E Value above quantitation range	H Holding times for preparation or analysis exceeded	
J Analyte detected below quantitation limits	L Analyzed by another laboratory	
M Value exceeds Monthly Ave or MCL or is less than LCL	ND Not Detected at the Reporting Limit	
O Outside the Range of Dilutions	S Spike Recovery outside accepted recovery limits	
X Matrix Effect		

Reviewed by:

Wade Nieuwsma, Assistant Laboratory Manager

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Your Environmental Monitoring Partner

Sample Analysis Report

Company: Dawn Mining Company
8809 Washington St. NE Suite 150
Albuquerque, NM 87113 **Date Reported:** 7/20/2016
Report ID: S1607240001

ProjectName: Midnite Mine **WorkOrder:** S1607240
Lab ID: S1607240-006 **CollectionDate:** 6/16/2016 1:43:00 PM
ClientSample ID: CORR21-0015-SOI-DIS-01 **DateReceived:** 7/18/2016 10:15:00 AM
COC: WEB **FieldSampler:** DA
Matrix: Solid

Comments

Analyses	Result	Units	Qual	RL	Method	Date Analyzed/Init
Radionuclides - Total						
Radium 226	15.6	pCi/g		0.4	E901.1 Mod.	07/19/2016 814 MB
Radium 226 Precision (\pm)	0.4	pCi/g			E901.1 Mod.	07/19/2016 814 MB

These results apply only to the samples tested.**RL - Reporting Limit**

Qualifiers: B Analyte detected in the associated Method Blank
E Value above quantitation range
J Analyte detected below quantitation limits
M Value exceeds Monthly Ave or MCL or is less than LCL
O Outside the Range of Dilutions
X Matrix Effect

C Calculated Value
H Holding times for preparation or analysis exceeded
L Analyzed by another laboratory
ND Not Detected at the Reporting Limit
S Spike Recovery outside accepted recovery limits

Reviewed by: A. Nieuwsma

Wade Nieuwsma, Assistant Laboratory Manager

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Your Environmental Monitoring Partner

Sample Analysis Report

Company: Dawn Mining Company
8809 Washington St. NE Suite 150
Albuquerque, NM 87113 **Date Reported:** 7/20/2016
Report ID: S1607240001

ProjectName: Midnite Mine **WorkOrder:** S1607240
Lab ID: S1607240-007 **CollectionDate:** 6/16/2016 1:59:00 PM
ClientSample ID: CORR22-0015-SOI-DIS-01 **DateReceived:** 7/18/2016 10:15:00 AM
COC: WEB **FieldSampler:** DA
Matrix: Solid

Comments

Analyses	Result	Units	Qual	RL	Method	Date Analyzed/Init	
Radionuclides - Total							
Radium 226	9.4	pCi/g		0.4	E901.1 Mod.	07/19/2016 932	MB
Radium 226 Precision (\pm)	0.3	pCi/g			E901.1 Mod.	07/19/2016 932	MB

These results apply only to the samples tested.**RL - Reporting Limit**

Qualifiers: B Analyte detected in the associated Method Blank
E Value above quantitation range
J Analyte detected below quantitation limits
M Value exceeds Monthly Ave or MCL or is less than LCL
O Outside the Range of Dilutions
X Matrix Effect

C Calculated Value
H Holding times for preparation or analysis exceeded
L Analyzed by another laboratory
ND Not Detected at the Reporting Limit
S Spike Recovery outside accepted recovery limits

Reviewed by:

Wade Nieuwsma, Assistant Laboratory Manager

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Sample Analysis Report

Company: Dawn Mining Company
8809 Washington St. NE Suite 150
Albuquerque, NM 87113 **Date Reported:** 7/20/2016
Report ID: S1607240001

ProjectName: Midnite Mine **WorkOrder:** S1607240
Lab ID: S1607240-008 **CollectionDate:** 6/16/2016 2:44:00 PM
ClientSample ID: CORR23-0015-SOI-DIS-01 **DateReceived:** 7/18/2016 10:15:00 AM
COC: WEB **FieldSampler:** DA
Matrix: Solid

Comments

Analyses	Result	Units	Qual	RL	Method	Date Analyzed/Init
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Radionuclides - Total

Radium 226	1.5	pCi/g		0.4	E901.1 Mod.	07/19/2016 1050	MB
Radium 226 Precision (\pm)	0.2	pCi/g			E901.1 Mod.	07/19/2016 1050	MB

These results apply only to the samples tested.**RL - Reporting Limit**

Qualifiers:	B Analyte detected in the associated Method Blank	C Calculated Value
E Value above quantitation range	H Holding times for preparation or analysis exceeded	
J Analyte detected below quantitation limits	L Analyzed by another laboratory	
M Value exceeds Monthly Ave or MCL or is less than LCL	ND Not Detected at the Reporting Limit	
O Outside the Range of Dilutions	S Spike Recovery outside accepted recovery limits	
X Matrix Effect		

Reviewed by:

Wade Nieuwsma, Assistant Laboratory Manager

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Inter-Mountain Labs

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Sample Analysis Report

Company:	Dawn Mining Company 8809 Washington St. NE Suite 150 Albuquerque, NM 87113	Date Reported	7/20/2016
		Report ID	S1607240001
ProjectName:	Midnite Mine	WorkOrder:	S1607240
Lab ID:	S1607240-009	CollectionDate:	6/21/2016 11:59:00 AM
ClientSample ID:	CORR24-0015-SOI-DIS-01	DateReceived:	7/18/2016 10:15:00 AM
COC:	WEB	FieldSampler:	DA
		Matrix:	Solid

Comments

Analyses	Result	Units	Qual	RL	Method	Date Analyzed/Init	
Radionuclides - Total							
Radium 226	1.9	pCi/g		0.4	E901.1 Mod.	07/19/2016 1209	MB
Radium 226 Precision (\pm)	0.2	pCi/g			E901.1 Mod.	07/19/2016 1209	MB

These results apply only to the samples tested.**RL - Reporting Limit**

Qualifiers:	B Analyte detected in the associated Method Blank	C Calculated Value
E Value above quantitation range	H Holding times for preparation or analysis exceeded	
J Analyte detected below quantitation limits	L Analyzed by another laboratory	
M Value exceeds Monthly Ave or MCL or is less than LCL	ND Not Detected at the Reporting Limit	
O Outside the Range of Dilutions	S Spike Recovery outside accepted recovery limits	
X Matrix Effect		

Reviewed by: A. Nieuwsma

Wade Nieuwsma, Assistant Laboratory Manager

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Inter-Mountain Labs

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

ANALYTICAL QC SUMMARY REPORT

CLIENT: Dawn Mining Company
Work Order: S1607240
Project: Midnite Mine

Date: 7/20/2016**Report ID:** S1607240001**Radium By Gamma Spectroscopy in Soil**Sample Type **MBLK**

Units: pCi/g

MB-12025 (07/18/16 11:31)	RunNo: 136518	PrepDate: 06/13/16 9:44	BatchID: 12025				
Analyte	Result	RL	Spike	Ref Samp	%REC	% Rec Limits	Qual
Radium 226	ND	0.2					

Radium By Gamma Spectroscopy in SoilSample Type **LCS**

Units: pCi/g

LCS-12025 (07/18/16 12:52)	RunNo: 136518	PrepDate: 06/13/16 9:44	BatchID: 12025				
Analyte	Result	RL	Spike	Ref Samp	%REC	% Rec Limits	Qual
Radium 226	37.2	0.2	37.9		98.2	70 - 130	

ROCKYFLATS (07/19/16 14:43)	RunNo: 136518	PrepDate: 06/02/16 0:00	BatchID: 12025				
Analyte	Result	RL	Spike	Ref Samp	%REC	% Rec Limits	Qual
Radium 226	0.9	0.2	1.15		80.7	70 - 130	

UTS-4 (07/19/16 16:01)	RunNo: 136518	PrepDate: 11/12/10 0:00	BatchID: 12025				
Analyte	Result	RL	Spike	Ref Samp	%REC	% Rec Limits	Qual
Radium 226	845	0.2	978		86.4	70 - 130	

Radium By Gamma Spectroscopy in SoilSample Type **DUP**

Units: pCi/g

S1607240-009AD (07/19/16 13:26)	RunNo: 136518	PrepDate: 06/21/16 11:59	BatchID: 12025				
Analyte	Result	RL	Ref Samp	%RPD	%REC	% RPD Limits	Qual
Radium 226	1.7	0.4	1.9	7.95		20	

Qualifiers: B Analyte detected in the associated Method Blank
H Holding times for preparation or analysis exceeded
L Analyzed by another laboratory
O Outside the Range of Dilutions
S Spike Recovery outside accepted recovery limits

E Value above quantitation range
J Analyte detected below quantitation limits
ND Not Detected at the Reporting Limit
R RPD outside accepted recovery limits
X Matrix Effect

Radium Analysis by Gamma Spectroscopy

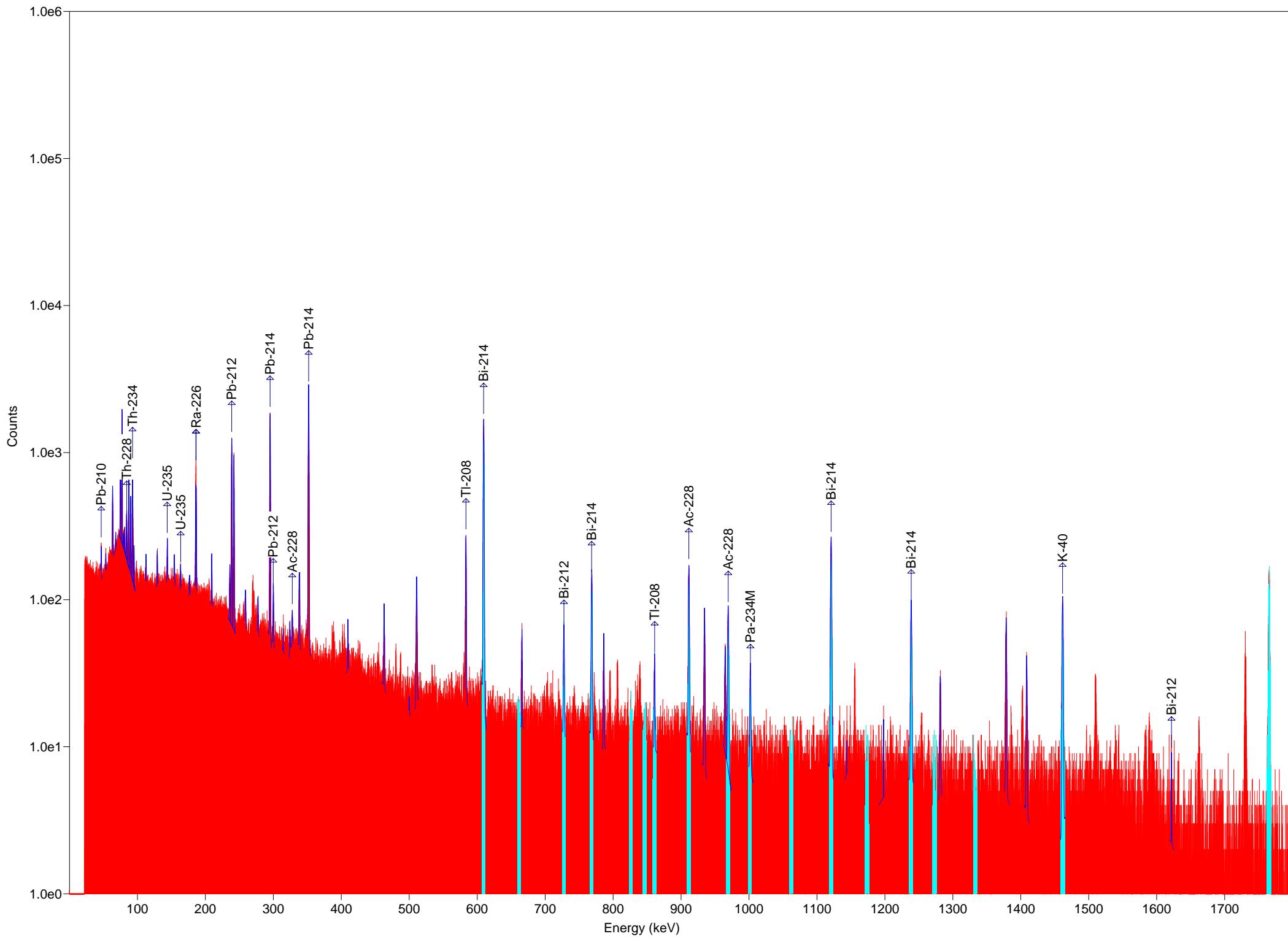
Instrument Batch: 16-20

Omega Run 136518

SampID	SampID	SampID	Analyte	Text Rslt	Counts	Error	Time	Result	95% CI	Weight	Samp Type	Prep
MB-12025	7/18/16 11:31	RAD_GAMMA_RA_S	Radium 226		2	12	4500	-0.14	0.09	150	MBLK	12025
LCS-12025	7/18/16 12:52	RAD_GAMMA_RA_S	Radium 226		10078	108	4500	37.24	0.78	150.02	LCS	12025
S1607240-001A	7/18/16 14:33	RAD_GAMMA_RA_S	Radium 226	1.1 ± 0.2	301	23	4500	1.13	0.19	129.43	SAMP	12025
S1607240-002A	7/18/16 15:50	RAD_GAMMA_RA_S	Radium 226	1.4 ± 0.2	439	25	4500	1.37	0.17	162.16	SAMP	12025
S1607240-003A	7/18/16 17:18	RAD_GAMMA_RA_S	Radium 226	11.8 ± 0.4	3225	62	4500	11.83	0.45	149.85	SAMP	12025
S1607240-004A	7/18/16 18:36	RAD_GAMMA_RA_S	Radium 226	2.6 ± 0.2	869	35	4500	2.62	0.22	176.13	SAMP	12025
S1607240-005A	7/18/16 23:11	RAD_GAMMA_RA_S	Radium 226	8.9 ± 0.3	3078	60	4500	8.85	0.34	190.98	SAMP	12025
S1607240-006A	7/19/16 8:14	RAD_GAMMA_RA_S	Radium 226	15.6 ± 0.4	5334	78	4500	15.58	0.45	189.06	SAMP	12025
S1607240-007A	7/19/16 9:32	RAD_GAMMA_RA_S	Radium 226	9.4 ± 0.3	3502	64	4500	9.39	0.34	205.19	SAMP	12025
S1607240-008A	7/19/16 10:50	RAD_GAMMA_RA_S	Radium 226	1.5 ± 0.2	416	26	4500	1.50	0.20	139.96	SAMP	12025
S1607240-009A	7/19/16 12:09	RAD_GAMMA_RA_S	Radium 226	1.9 ± 0.2	523	29	4500	1.86	0.22	144.95	SAMP	12025
S1607240-009AD	7/19/16 13:26	RAD_GAMMA_RA_S	Radium 226		486	29	4500	1.72	0.22	144.95	DUP	12025
ROCKYFLATS	7/19/16 14:43	RAD_GAMMA_RA_S	Radium 226		163	19	4500	0.93	0.28	74.21	LCS	12025
UTS-4	7/19/16 16:01	RAD_GAMMA_RA_S	Radium 226		7629	93	4500	844.72	20.18	5	LCS	12025

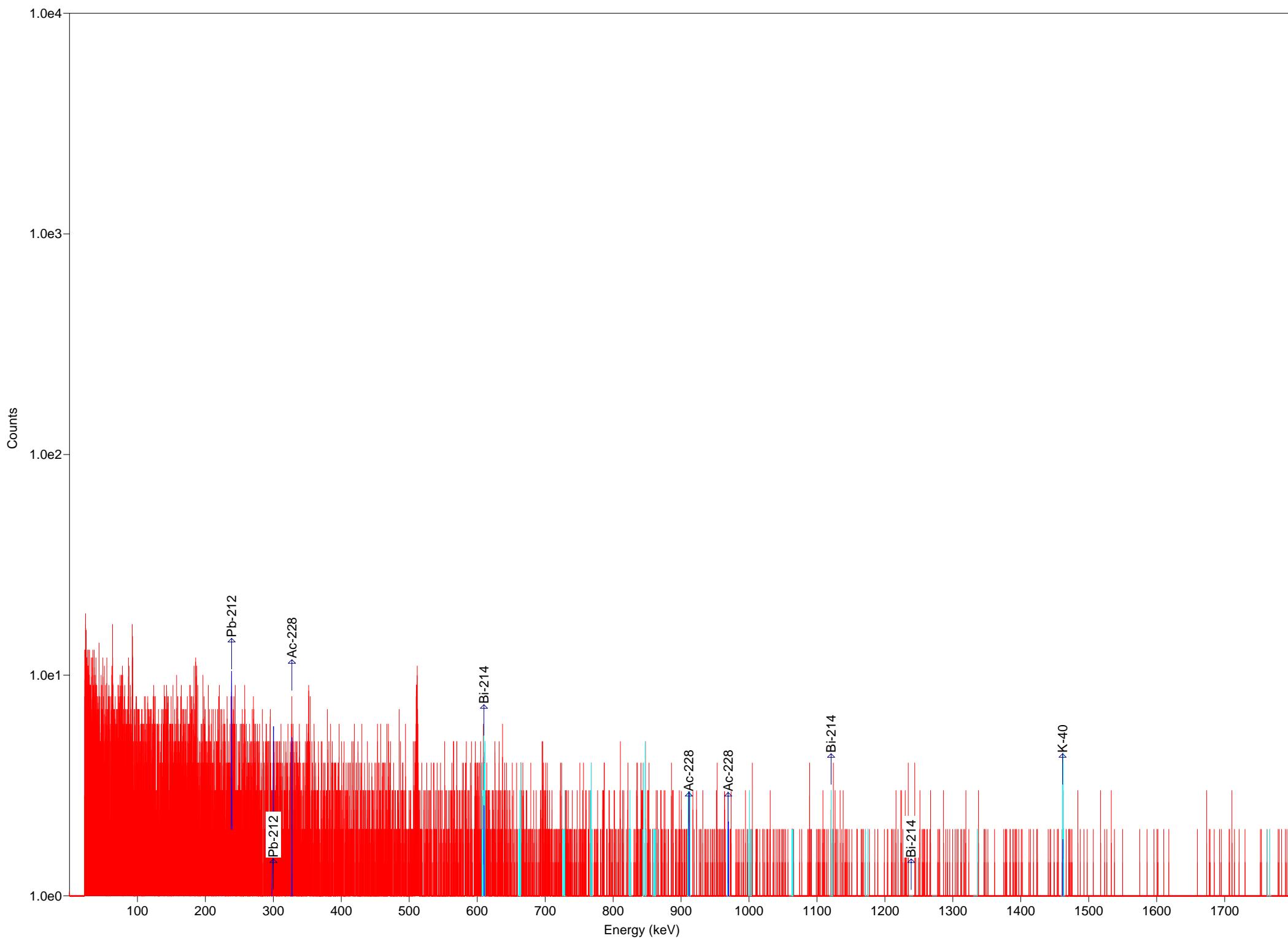
Reviewed By MRC 7/20/16

LCS-12025 LCS	RAD_GAM| ##### Radium 22	37.23793 pCi/g	1	0 LCS-12025
MB-12025 MBLK	RAD_GAM| ##### Radium 22	-0.13808 pCi/g	1	0 MB-12025
ROCKYFLATLCS	RAD_GAM| ##### Radium 22	0.92821 pCi/g	1	0 ROCKYFLATS
S1607240-ISAMP	RAD_GAM| ##### Radium 22	1.125531 pCi/g	1.1 ± 0.2	1 S1607240-001A
S1607240-ISAMP	RAD_GAM| ##### Radium 22	1.371931 pCi/g	1.4 ± 0.2	1 S1607240-002A
S1607240-ISAMP	RAD_GAM| ##### Radium 22	11.83077 pCi/g	11.8 ± 0.4	1 S1607240-003A
S1607240-ISAMP	RAD_GAM| ##### Radium 22	2.621706 pCi/g	2.6 ± 0.2	1 S1607240-004A
S1607240-ISAMP	RAD_GAM| ##### Radium 22	8.854525 pCi/g	8.9 ± 0.3	1 S1607240-005A
S1607240-ISAMP	RAD_GAM| ##### Radium 22	15.58483 pCi/g	15.6 ± 0.4	1 S1607240-006A
S1607240-ISAMP	RAD_GAM| ##### Radium 22	9.391233 pCi/g	9.4 ± 0.3	1 S1607240-007A
S1607240-ISAMP	RAD_GAM| ##### Radium 22	1.498094 pCi/g	1.5 ± 0.2	1 S1607240-008A
S1607240-ISAMP	RAD_GAM| ##### Radium 22	1.857311 pCi/g	1.9 ± 0.2	1 S1607240-009A
S1607240-IDUP	RAD_GAM| ##### Radium 22	1.715262 pCi/g		1 S1607240-009A
UTS-4 LCS	RAD_GAM| ##### Radium 22	844.7204 pCi/g	1	0 UTS-4



LCS-12025.Rpt

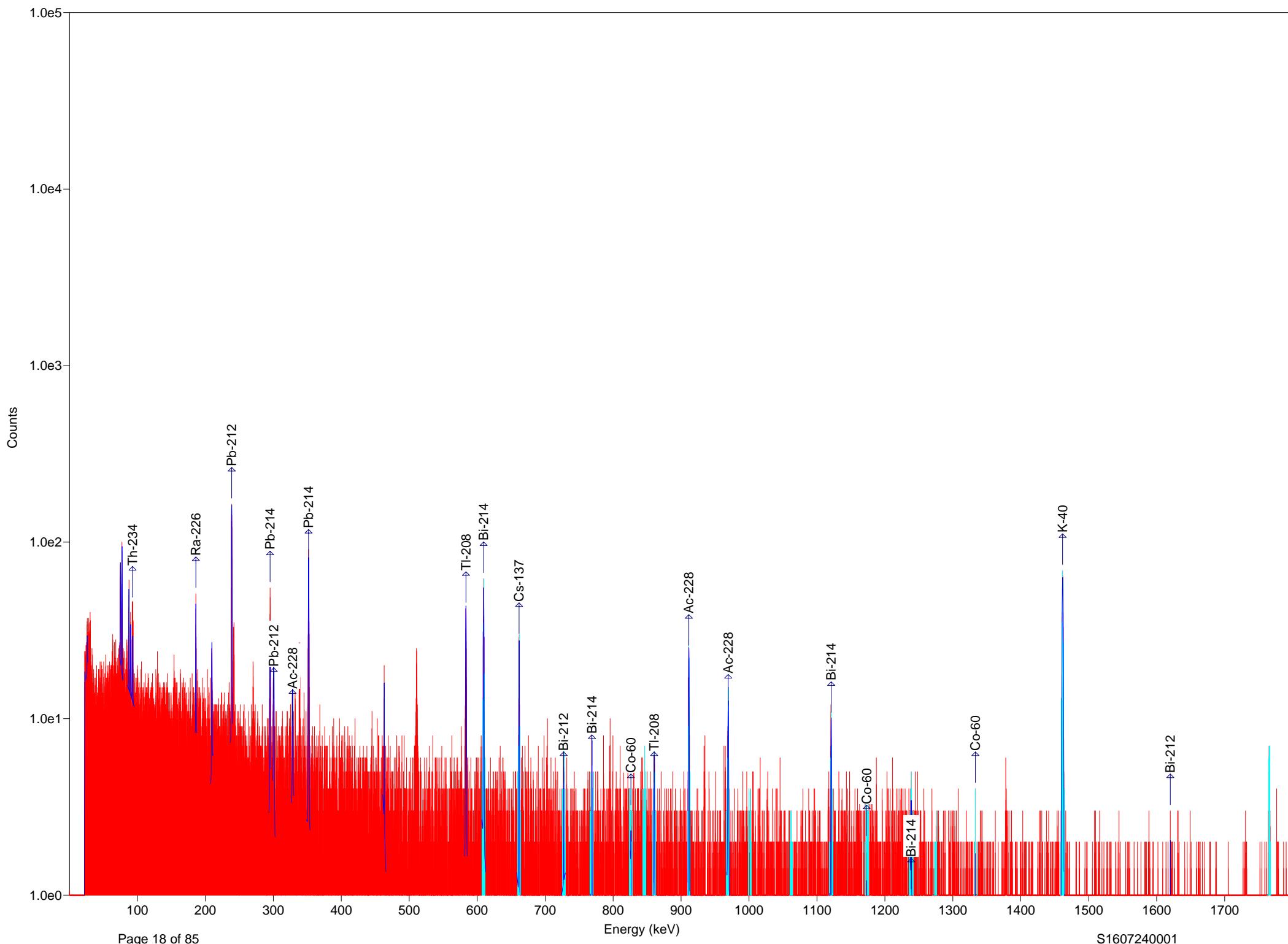
Detector #2	ACQ	18-Jul-2016 at 12:52:26	RT = 4521.8	LT = 4500.0						
Rad	Chem	2								
ROI#	RANGE(keV)	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY	(keV)	
	μCi	+/-								
1	606.93	611.75	10668	10078	108	609.35	1.28	1.98	Bi-214	609.31
0.0051	0.0001									
2	659.29	664.11	370	21	31	660.49	1.39	1.61	Cs-137	661.66
0.0000	0.0000									
3	724.58	729.84	697	351	38	727.37	1.46	2.25	Bi-212	727.00
0.0013	0.0001									
4	765.77	771.02	1256	881	45	768.47	1.44	2.09	Bi-214	768.36
0.0051	0.0003									
5	823.38	828.64	349	61	31	826.01	0.51	0.75	Co-60	826.28
0.2363	0.1201									
6	843.53	848.79	355	13	33	847.26	0.77	1.14	Co-56	846.77
0.0000	0.0000									
7	857.99	863.25	471	150	34	860.49	1.11	1.98	Tl-208	860.56
0.0004	0.0001									
8	908.38	914.07	1442	1113	47	911.22	1.41	2.17	Ac-228	911.20
0.0013	0.0001									
9	966.21	971.90	895	634	39	969.04	2.16	2.55	Ac-228	968.97
0.0013	0.0001									
10	998.19	1003.88	407	132	33	1001.49	1.49	2.44	Pa-234M	1001.03
0.0055	0.0014									
11	1059.08	1065.21	265	-49	33	1063.90	0.22	0.35	No close library	
match!										
12	1117.34	1123.47	2248	1919	56	1120.42	1.69	2.50	Bi-214	1120.29
0.0051	0.0001									
13	1170.34	1176.47	217	48	26	1171.93	0.30	0.51	Co-60	1173.24
0.0000	0.0000									
14	1235.17	1241.30	926	699	39	1238.24	1.66	2.48	Co-56	1238.28
0.0005	0.0000									
15	1269.55	1276.12	217	-21	31	1272.08	0.38	0.55	No close library	
match!										
16	1329.34	1335.91	181	-67	31	Could not properly fit the peak.				
17	1457.88	1464.45	1022	779	42	1460.96	1.68	2.69	K-40	1461.00
0.0038	0.0002									
18	1761.13	1768.13	1741	1642	45	1764.65	2.05	3.07	Bi-214	1764.49
0.0069	0.0002									



MB-12025.Rpt

Detector #2 ACQ 18-Jul-2016 at 11:31:44 RT = 4508.2 LT = 4500.0
 Rad Chem 2
 MB-200

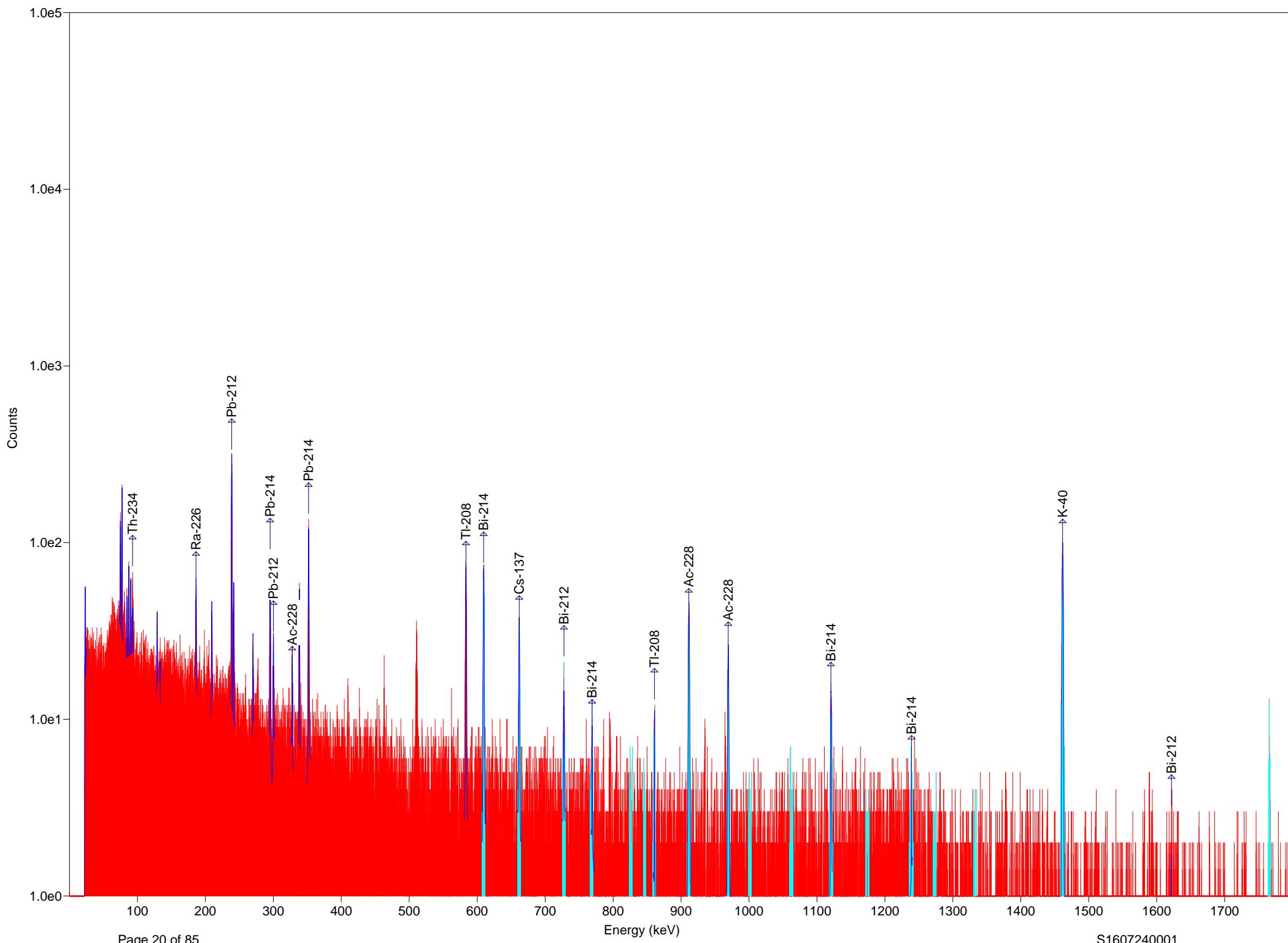
ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
1	606.93 611.75 0.0000 0.0000	56	2	12	609.23	0.43	0.62	Bi-214 609.31
2	659.29 664.11 0.0000 0.0000	22	-16	9	Could not properly fit the peak.			
3	724.58 729.84 0.0000 0.0000	24	-5	9	728.96	0.22	0.35	Bi-212 727.00
4	765.77 771.02 0.0000 0.0000	23	-2	8	767.74	0.22	0.35	Bi-214 768.36
5	823.38 828.64 0.0000 0.0310	18	-7	8	824.48	0.22	0.35	Co-60 826.28
6	843.53 848.79 0.0000 0.0000	34	-4	10	847.26	0.22	0.35	Co-56 846.77
7	857.99 863.25 0.0000 0.0000	23	-10	9	Could not properly fit the peak.			
8	908.38 914.07 0.0000 0.0000	32	18	8	912.32	0.26	2.41	Ac-228 911.20
9	966.21 971.90 0.0000 0.0000	20	6	7	968.71	0.48	0.94	Ac-228 968.97
10	998.19 1003.88 0.0000 0.0003	20	-3	8	1000.38	0.22	0.35	Pa-234M 1001.03
11	1059.08 1065.21 match!	19	9	6	1062.80	1.86	2.06	No close library
12	1117.34 1123.47 0.0000 0.0000	22	12	7	1120.42	0.69	1.26	Bi-214 1120.29
13	1170.34 1176.47 0.0000 0.0000	9	-1	6	1174.50	0.22	0.35	Co-60 1173.24
14	1235.17 1241.30 0.0001 0.0000	12	-7	8	Could not properly fit the peak.			
15	1269.55 1276.12 0.0000 0.0000	9	-7	7	Could not properly fit the peak.			
16	1329.34 1335.91 0.0001 0.0000	11	1	6	Could not properly fit the peak.			
17	1457.88 1464.45 0.0001 0.0000	29	24	6	1461.12	0.33	0.84	K-40 1461.00
18	1761.13 1768.13 0.0000 0.0000	13	2	7	1765.50	0.77	0.96	Bi-214 1764.49



S1607240-001A.Rpt

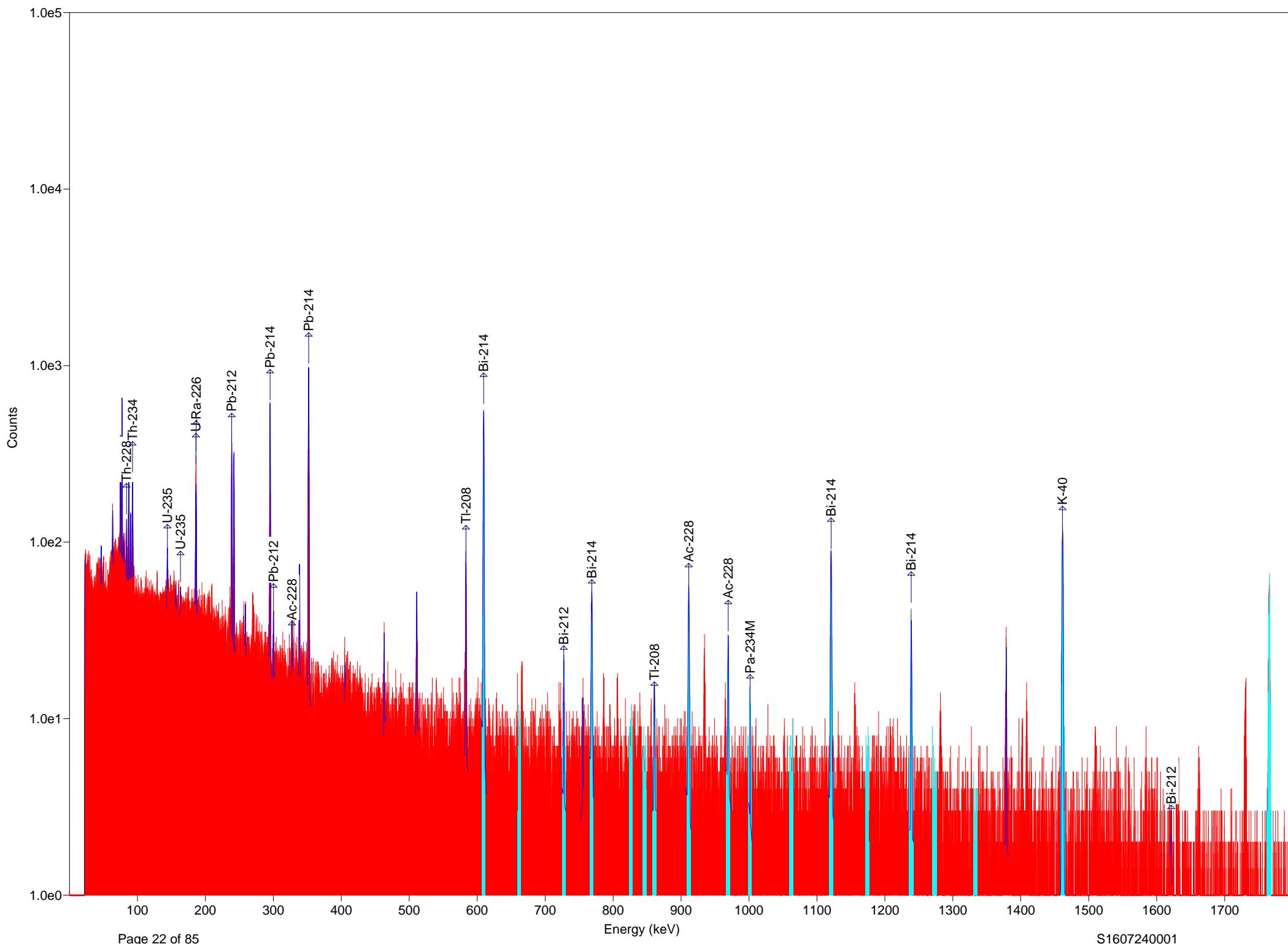
Detector #2 ACQ 18-Jul-2016 at 14:33:32 RT = 4509.1 LT = 4500.0
 Rad Chem 2
 S1607240-001A

ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
1	606.93 611.75 0.0002 0.0000	393	301	23	609.31	1.23	2.08	Bi-214 609.31
2	659.29 664.11 0.0000 0.0000	189	147	16	661.65	0.78	1.81	Cs-137 661.66
3	724.58 729.84 0.0002 0.0000	88	50	13	727.49	0.99	1.84	Bi-212 727.00
4	765.77 771.02 0.0002 0.0001	74	28	13	768.18	0.26	0.42	Bi-214 768.36
5	823.38 828.64 0.0000 0.0504	53	-5	13	824.48	2.08	2.28	Co-60 826.28
6	843.53 848.79 0.0000 0.0000	52	6	12	846.16	0.22	0.35	Co-56 846.77
7	857.99 863.25 0.0001 0.0000	68	30	12	860.40	0.38	1.78	Tl-208 860.56
8	908.38 914.07 0.0002 0.0000	195	159	16	911.03	1.12	2.05	Ac-228 911.20
9	966.21 971.90 0.0002 0.0000	113	77	14	969.21	1.44	2.35	Ac-228 968.97
10	998.19 1003.88 0.0000 0.0005	35	-1	11	1001.91	0.27	0.77	Pa-234M 1001.03
11	1059.08 1065.21 match!	34	0	11	1060.83	1.42	1.62	No close library
12	1117.34 1123.47 0.0002 0.0000	95	80	11	1120.52	1.68	2.82	Bi-214 1120.29
13	1170.34 1176.47 0.0000 0.0000	40	-13	13	1175.60	0.22	0.35	Co-60 1173.24
14	1235.17 1241.30 0.0000 0.0000	65	7	15	1238.65	0.64	0.78	Co-56 1238.28
15	1269.55 1276.12 match!	29	8	9	1275.46	0.33	0.53	No close library
16	1329.34 1335.91 0.0000 0.0000	22	1	9	1332.62	0.22	0.35	Co-60 1332.50
17	1457.88 1464.45 0.0027 0.0001	577	551	25	1461.12	1.76	2.58	K-40 1461.00
18	1761.13 1768.13 0.0003 0.0000	68	62	9	1764.40	1.90	2.74	Bi-214 1764.49



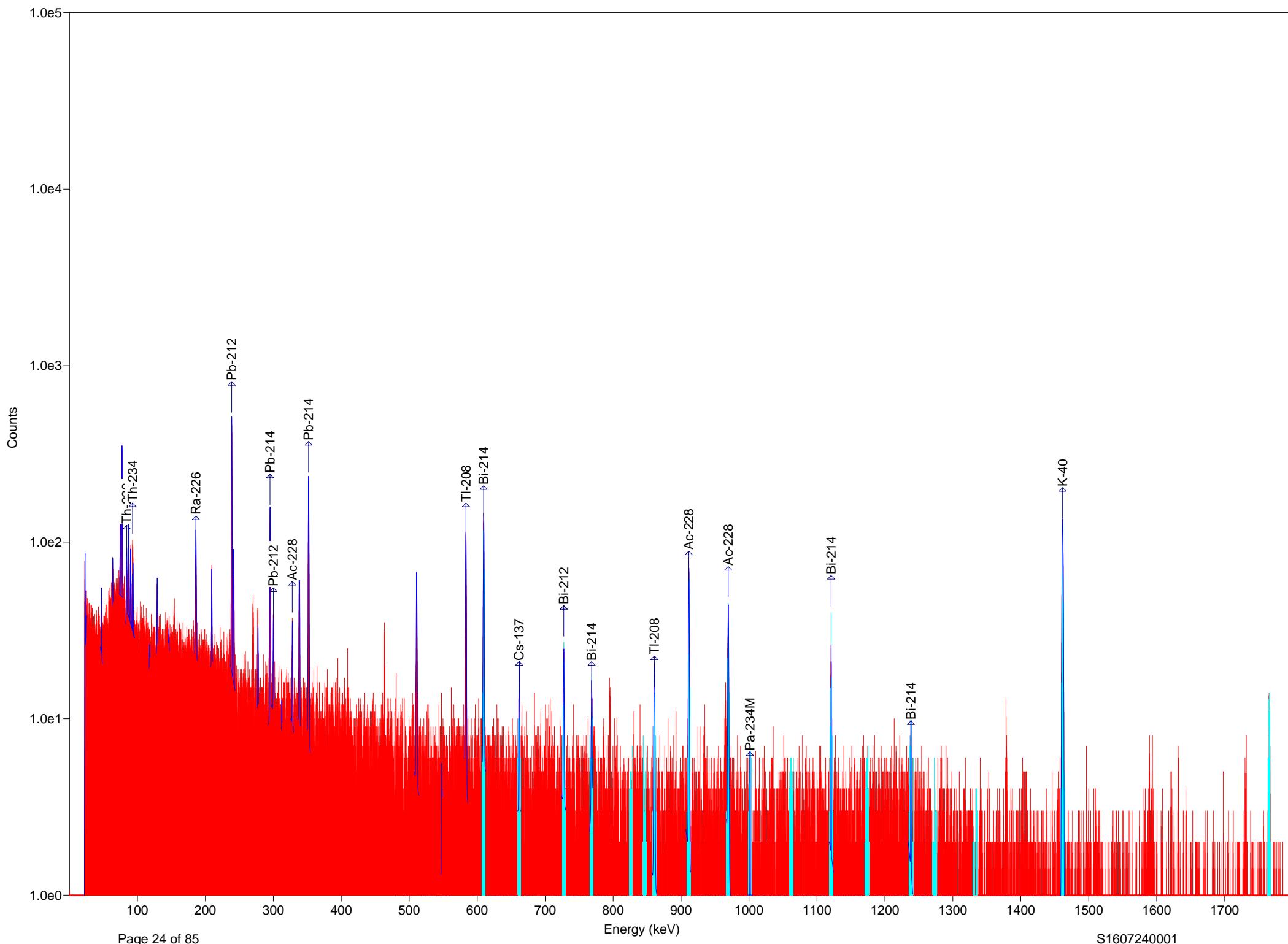
S1607240-002A.Rpt

Detector #2	ACQ	18-Jul-2016 at 15:50:17	RT = 4510.3	LT = 4500.0					
ROI#	RANGE(keV)	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY	(keV)
1	606.93 611.75 0.0002 0.0000	512	439	25	609.31	1.36	1.88	Bi-214	609.31
2	659.29 664.11 0.0001 0.0000	279	218	19	661.56	1.28	2.28	Cs-137	661.66
3	724.58 729.84 0.0004 0.0001	174	99	18	727.59	1.10	2.05	Bi-212	727.00
4	765.77 771.02 0.0003 0.0001	106	48	15	768.52	0.64	1.03	Bi-214	768.36
5	823.38 828.64 0.0000 0.0658	80	-33	17	824.70	3.29	3.42	Co-60	826.28
6	843.53 848.79 0.0000 0.0000	66	12	13	845.12	0.51	0.73	Co-56	846.77
7	857.99 863.25 0.0001 0.0000	101	47	14	860.69	0.42	1.16	Tl-208	860.56
8	908.38 914.07 0.0003 0.0000	335	267	22	911.06	1.61	2.14	Ac-228	911.20
9	966.21 971.90 0.0004 0.0000	213	177	17	969.14	1.52	2.43	Ac-228	968.97
10	998.19 1003.88 0.0000 0.0006	55	-4	14	1000.16	0.22	0.35	Pa-234M	1001.03
11	1059.08 1065.21 match!	68	-9	16	1060.51	0.39	0.55	No close library	
12	1117.34 1123.47 0.0003 0.0000	147	99	16	1120.29	1.22	2.35	Bi-214	1120.29
13	1170.34 1176.47 0.0000 0.0000	55	-18	16	1171.87	0.22	0.35	Co-60	1173.24
14	1235.17 1241.30 0.0001 0.0001	88	15	17	1237.83	0.28	1.16	Bi-214	1238.11
15	1269.55 1276.12 match!	46	5	13	1274.99	0.32	0.52	No close library	
16	1329.34 1335.91 0.0000 0.0000	38	12	10	1332.28	2.71	2.91	Co-60	1332.50
17	1457.88 1464.45 0.0041 0.0002	899	847	32	1460.98	1.92	2.91	K-40	1461.00
18	1761.13 1768.13 0.0002 0.0000	73	56	11	1764.64	0.41	1.75	Bi-214	1764.49



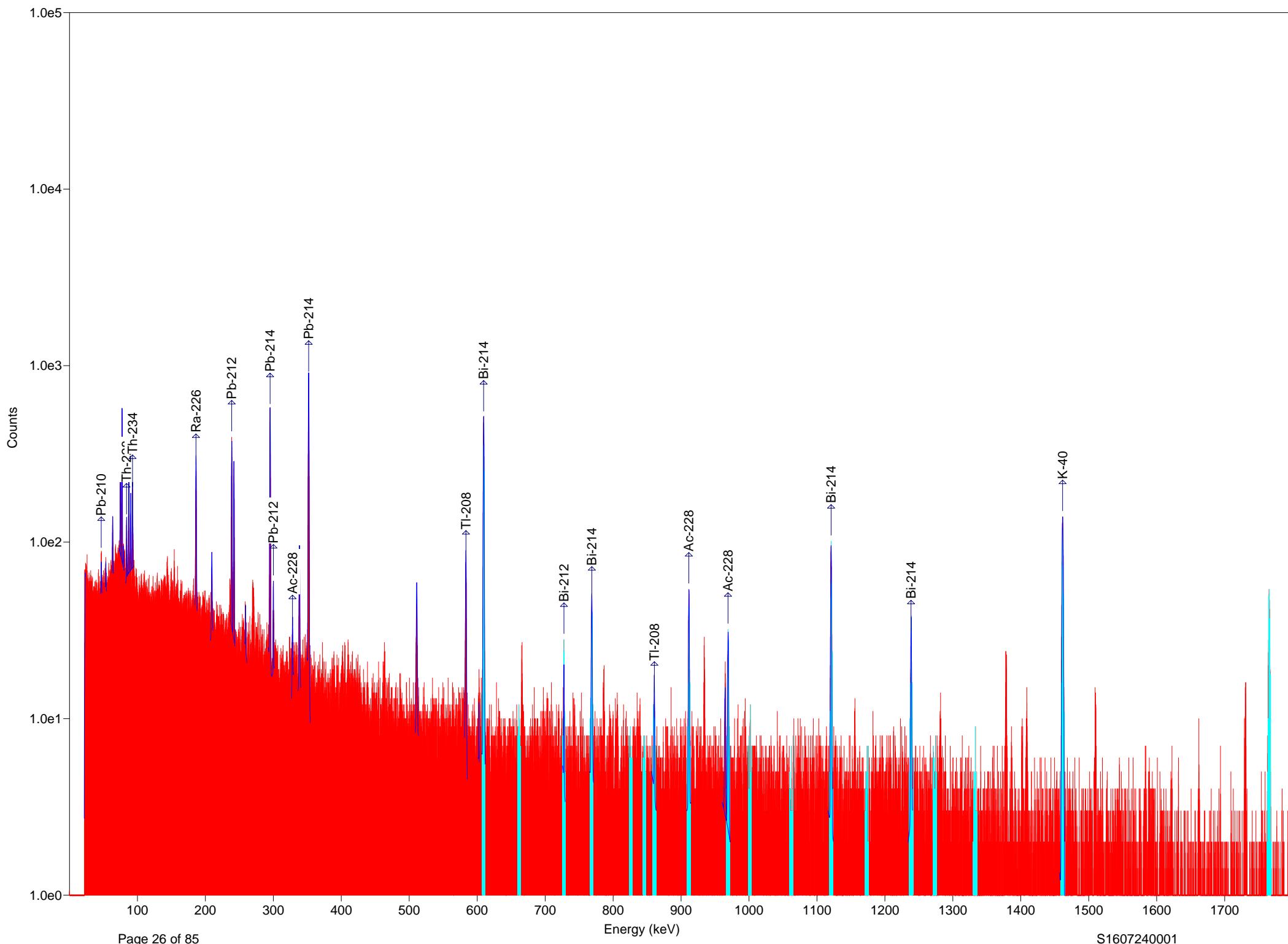
S1607240-003A.Rpt

Detector #2	ACQ	18-Jul-2016 at 17:18:06	RT = 4512.7	LT = 4500.0					
	Rad Chem 2								
	S1607240-003A								
ROI#	RANGE(keV)	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY	(keV)
	μCi +/-								
1	606.93 611.75 0.0016 0.0000	3482	3225	62	609.33	1.23	1.90	Bi-214	609.31
2	659.29 664.11 0.0000 0.0000	154	4	20	660.78	0.31	0.52	Cs-137	661.66
3	724.58 729.84 0.0004 0.0001	237	112	22	727.45	0.68	2.41	Bi-212	727.00
4	765.77 771.02 0.0018 0.0001	445	320	26	768.40	1.67	2.42	Bi-214	768.36
5	823.38 828.64 0.0658 0.0813	163	17	21	826.91	0.29	0.51	Co-60	826.28
6	843.53 848.79 0.0000 0.0000	123	-2	19	847.85	0.52	0.79	Co-56	846.77
7	857.99 863.25 0.0001 0.0000	168	51	20	859.98	0.40	1.68	Tl-208	860.56
8	908.38 914.07 0.0004 0.0000	455	338	27	911.15	1.70	2.67	Ac-228	911.20
9	966.21 971.90 0.0004 0.0001	302	167	25	969.08	1.25	2.30	Ac-228	968.97
10	998.19 1003.88 0.0018 0.0009	160	43	21	1000.58	0.25	0.41	Pa-234M	1001.03
11	1059.08 1065.21 match!	135	38	20	1064.14	0.29	0.78	No close library	
12	1117.34 1123.47 0.0017 0.0001	767	632	33	1120.40	1.76	2.42	Bi-214	1120.29
13	1170.34 1176.47 0.0000 0.0000	122	59	17	1174.72	0.31	1.64	Co-60	1173.24
14	1235.17 1241.30 0.0002 0.0000	347	255	24	1238.34	1.26	2.16	Co-56	1238.28
15	1269.55 1276.12 match!	101	-2	20	1271.08	3.78	3.99	No close library	
16	1329.34 1335.91 0.0000 0.0000	71	-1	17	1333.28	1.97	2.10	Co-60	1332.50
17	1457.88 1464.45 0.0047 0.0002	1052	964	36	1460.92	1.88	2.66	K-40	1461.00
18	1761.13 1768.13 0.0024 0.0001	604	560	27	1764.70	2.00	3.07	Bi-214	1764.49



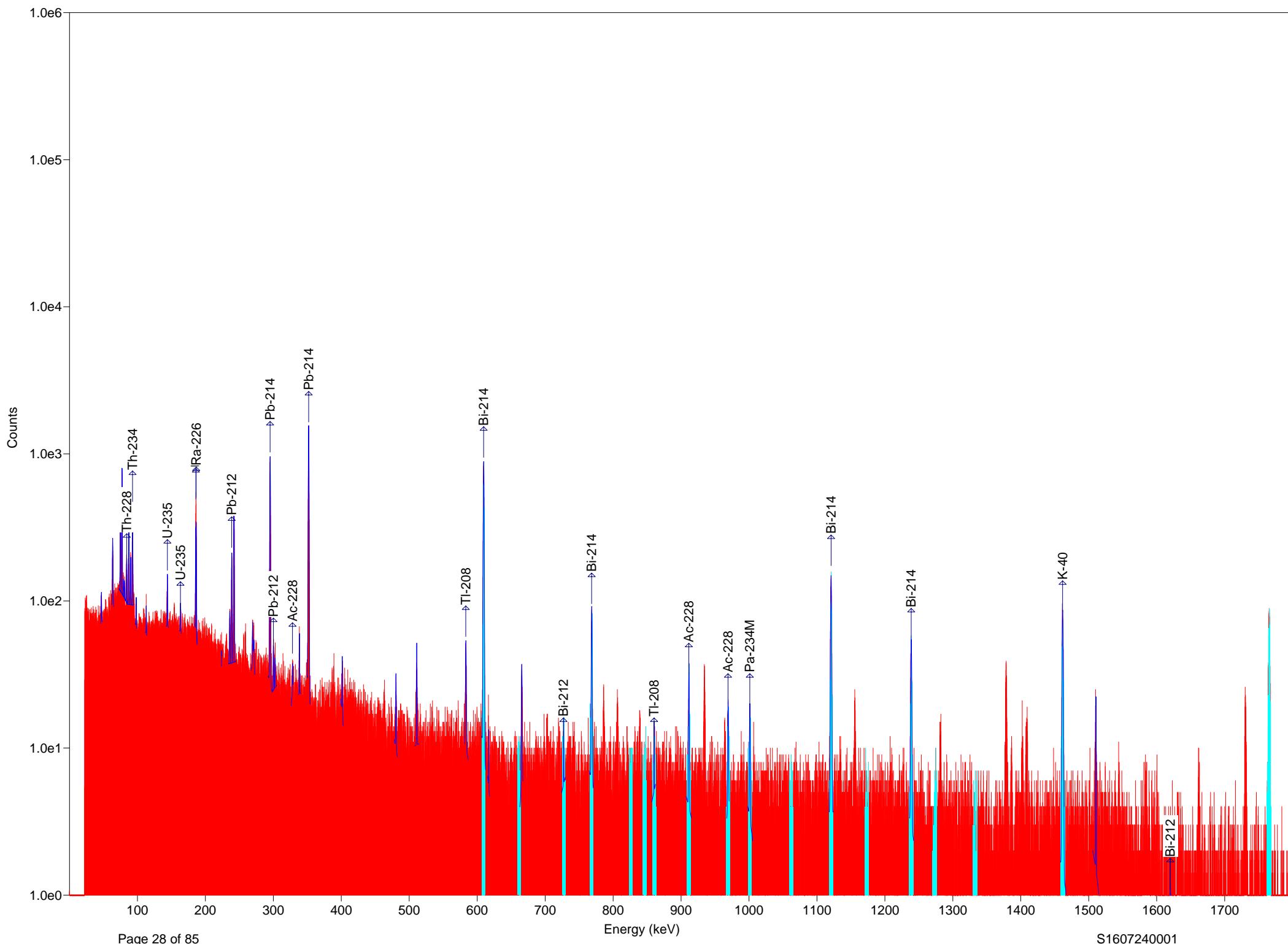
S1607240-004A.Rpt

Detector #2	ACQ	18-Jul-2016 at 18:36:58	RT = 4510.4	LT = 4500.0					
ROI#	RANGE(keV)	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY	(keV)
	Rad Chem 2 S1607240-004A								
	μCi	$+$ / $-$							
1	606.93 611.75 0.0004 0.0000	1003	869	35	609.34	1.23	2.01	Bi-214	609.31
2	659.29 664.11 0.0000 0.0000	184	80	19	661.80	1.18	1.88	Cs-137	661.66
3	724.58 729.84 0.0005 0.0001	243	143	21	727.28	1.55	2.14	Bi-212	727.00
4	765.77 771.02 0.0003 0.0001	186	53	21	768.41	1.24	1.55	Bi-214	768.36
5	823.38 828.64 0.0271 0.0581	78	7	15	824.60	3.76	4.00	Co-60	826.28
6	843.53 848.79 0.0000 0.0000	91	20	15	844.19	4.13	4.28	Co-56	846.77
7	857.99 863.25 0.0002 0.0000	151	63	18	860.74	1.19	1.70	Tl-208	860.56
8	908.38 914.07 0.0005 0.0000	539	471	26	911.25	1.36	2.27	Ac-228	911.20
9	966.21 971.90 0.0006 0.0000	355	278	23	968.99	1.62	2.50	Ac-228	968.97
10	998.19 1003.88 0.0000 0.0008	99	-5	18	1001.69	0.25	0.39	Pa-234M	1001.03
11	1059.08 1065.21 match!	81	-6	18	1059.83	2.43	2.55	No close library	
12	1117.34 1123.47 0.0005 0.0001	260	197	20	1120.42	0.39	2.14	Bi-214	1120.29
13	1170.34 1176.47 0.0000 0.0000	87	10	17	1174.25	0.28	0.76	Co-60	1173.24
14	1235.17 1241.30 0.0000 0.0000	142	60	19	1238.75	0.54	2.17	Co-56	1238.28
15	1269.55 1276.12 match!	60	-7	16	1272.18	0.26	0.44	No close library	
16	1329.34 1335.91 0.0000 0.0000	43	-19	15	1333.28	0.88	1.01	Co-60	1332.50
17	1457.88 1464.45 0.0056 0.0002	1228	1161	37	1460.98	1.82	2.92	K-40	1461.00
18	1761.13 1768.13 0.0006 0.0001	153	142	13	1764.31	2.40	3.42	Bi-214	1764.49



S1607240-005A.Rpt

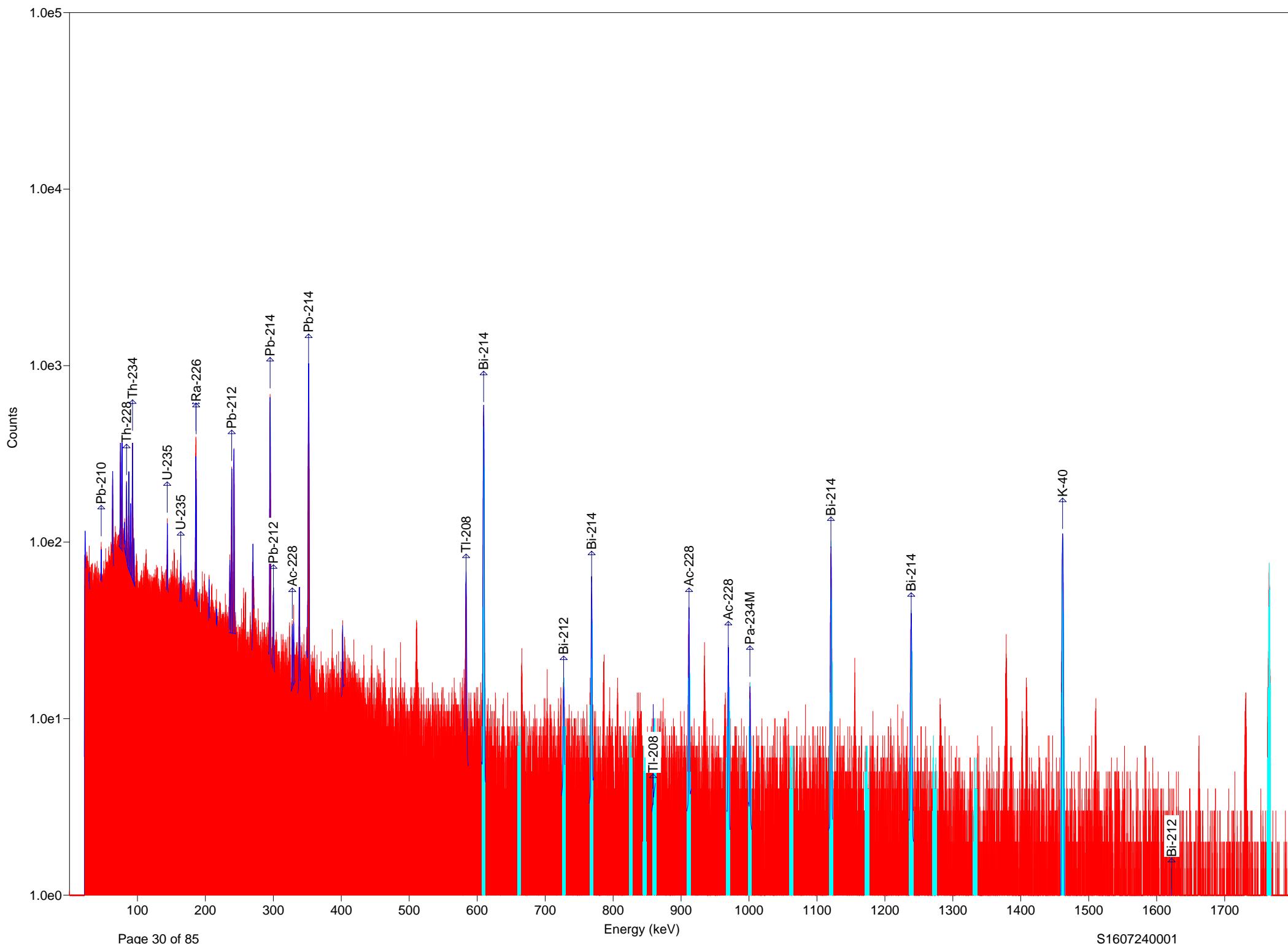
Detector #2	ACQ	18-Jul-2016 at 23:11:39	RT = 4539.4	LT = 4500.0					
Rad	Chem	2							
S1607240-005A									
ROI#	RANGE(keV)	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY	(keV)
	μCi	+/-							
1	606.93 611.75 0.0016 0.0000	3277	3078	60	609.34	1.32	1.98	Bi-214	609.31
2	659.29 664.11 0.0000 0.0000	147	1	20	661.24	0.27	0.48	Cs-137	661.66
3	724.58 729.84 0.0004 0.0001	249	103	23	727.60	0.79	2.18	Bi-212	727.00
4	765.77 771.02 0.0014 0.0002	430	242	28	768.37	1.39	1.87	Bi-214	768.36
5	823.38 828.64 0.0000 0.0736	118	-11	19	825.35	0.26	0.44	Co-60	826.28
6	843.53 848.79 0.0000 0.0000	128	11	19	844.95	1.89	2.17	Co-56	846.77
7	857.99 863.25 0.0001 0.0001	186	57	21	860.44	0.83	1.43	Tl-208	860.56
8	908.38 914.07 0.0004 0.0000	449	305	28	911.32	1.30	2.13	Ac-228	911.20
9	966.21 971.90 0.0004 0.0001	309	196	24	968.96	1.41	2.27	Ac-228	968.97
10	998.19 1003.88 0.0015 0.0008	140	36	19	1001.64	0.30	1.14	Pa-234M	1001.03
11	1059.08 1065.21 match!	97	-34	21	1062.14	2.41	2.54	No close library	
12	1117.34 1123.47 0.0018 0.0001	800	689	33	1120.43	1.38	2.41	Bi-214	1120.29
13	1170.34 1176.47 0.0000 0.0000	94	2	18	1173.41	1.97	2.10	Co-60	1173.24
14	1235.17 1241.30 0.0002 0.0000	360	249	25	1238.27	1.35	2.65	Co-56	1238.28
15	1269.55 1276.12 match!	103	20	19	1274.37	0.22	0.35	No close library	
16	1329.34 1335.91 0.0000 0.0000	79	7	17	1332.84	0.22	0.35	Co-60	1332.50
17	1457.88 1464.45 0.0056 0.0002	1266	1157	40	1460.97	1.95	2.88	K-40	1461.00
18	1761.13 1768.13 0.0021 0.0001	554	510	26	1764.66	1.65	3.11	Bi-214	1764.49



S1607240-006A.Rpt

Detector #2 ACQ 19-Jul-2016 at 8:14:14 RT = 4514.3 LT = 4500.0
 Rad Chem 2
 S1607240-006A

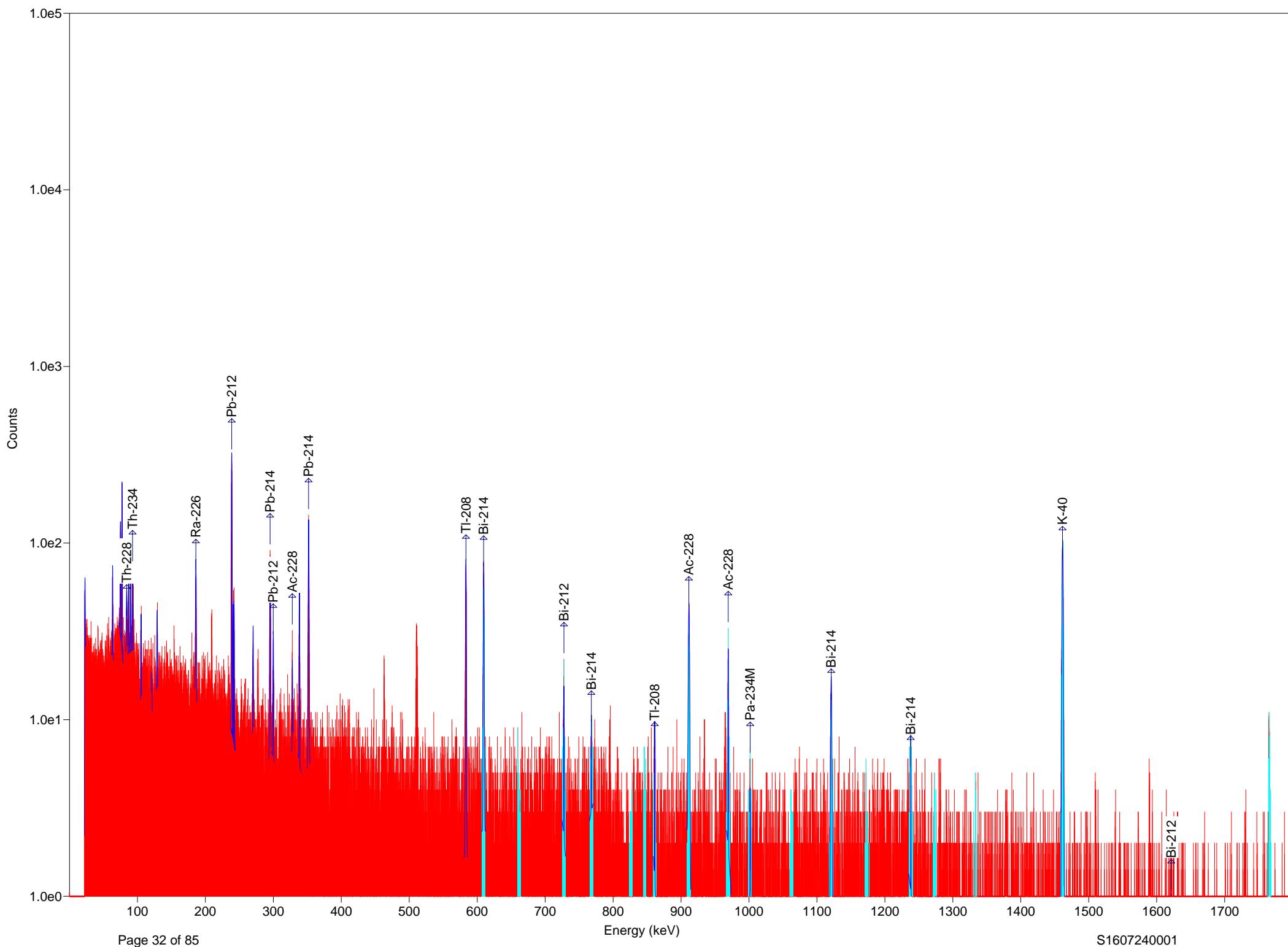
ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
1	606.93 611.75 0.0027 0.0000	5610	5334	78	609.33	1.31	1.97	Bi-214 609.31
2	659.29 664.11 0.0000 0.0000	183	-5	22	661.26	2.41	2.54	Cs-137 661.66
3	724.58 729.84 0.0002 0.0001	242	63	25	727.45	0.39	1.15	Bi-212 727.00
4	765.77 771.02 0.0026 0.0002	725	446	36	768.44	1.21	1.94	Bi-214 768.36
5	823.38 828.64 0.0000 0.0852	158	-5	22	824.70	1.35	1.53	Co-60 826.28
6	843.53 848.79 0.0000 0.0000	167	4	22	847.68	0.25	0.43	Co-56 846.77
7	857.99 863.25 0.0001 0.0001	207	24	24	860.82	0.28	0.80	Tl-208 860.56
8	908.38 914.07 0.0002 0.0000	346	161	28	911.36	0.99	1.72	Ac-228 911.20
9	966.21 971.90 0.0002 0.0000	242	116	23	968.52	1.66	2.49	Ac-228 968.97
10	998.19 1003.88 0.0028 0.0010	219	66	24	1000.72	1.05	1.90	Pa-234M 1001.03
11	1059.08 1065.21 match!	137	-13	23	1061.71	0.22	0.35	No close library
12	1117.34 1123.47 0.0029 0.0001	1252	1112	40	1120.36	1.63	2.49	Bi-214 1120.29
13	1170.34 1176.47 0.0000 0.0000	140	0	23	1175.38	0.29	1.18	Co-60 1173.24
14	1235.17 1241.30 0.0031 0.0002	514	417	28	1238.13	1.84	2.68	Bi-214 1238.11
15	1269.55 1276.12 match!	124	5	22	1274.37	0.22	0.35	No close library
16	1329.34 1335.91 0.0000 0.0000	94	-25	21	1332.84	2.41	2.54	Co-60 1332.50
17	1457.88 1464.45 0.0035 0.0002	805	722	32	1460.88	1.95	2.84	K-40 1461.00
18	1761.13 1768.13 0.0037 0.0001	952	891	34	1764.67	2.05	3.15	Bi-214 1764.49



S1607240-007A.Rpt

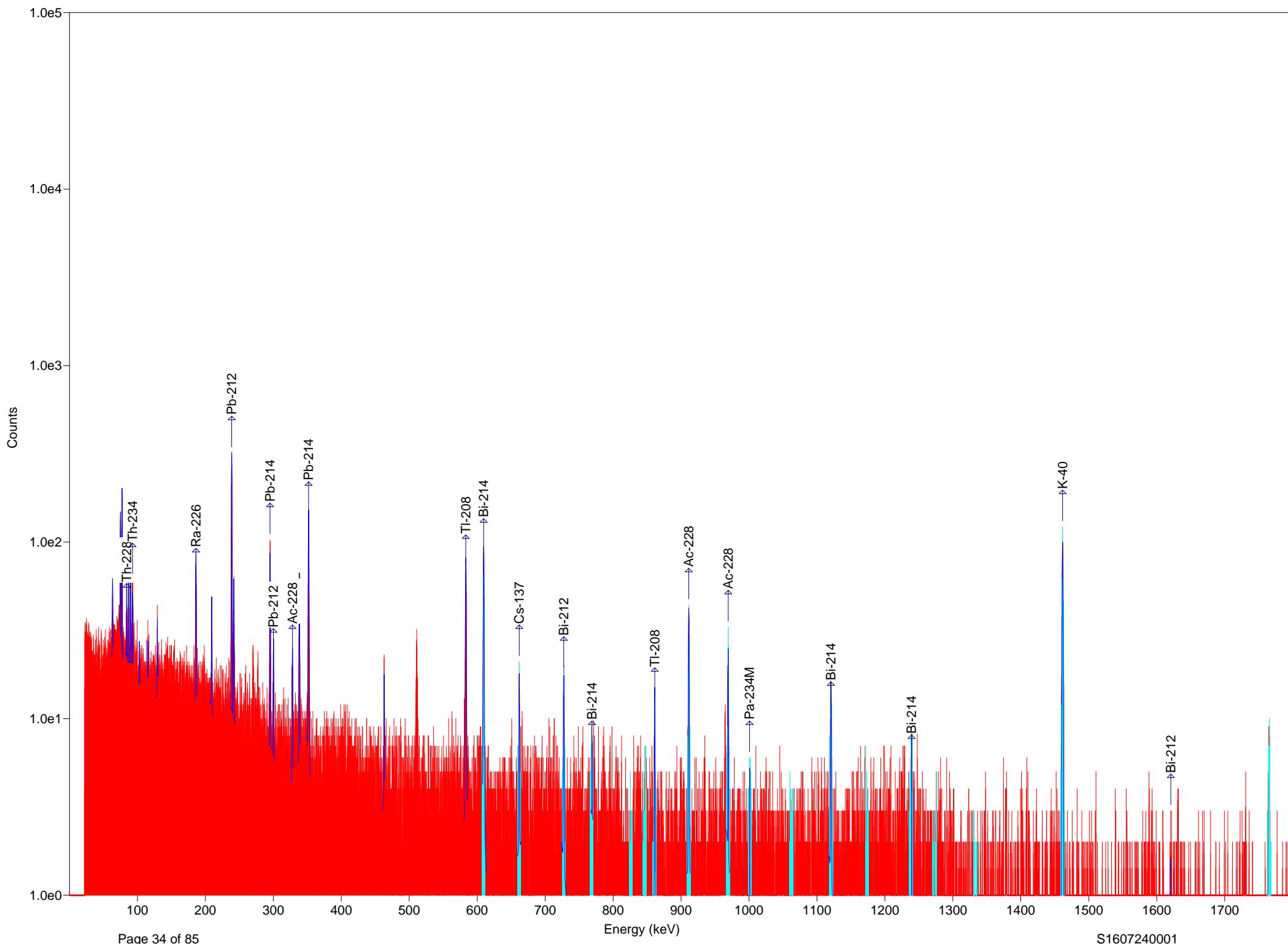
Detector #2 ACQ 19-Jul-2016 at 9:32:28 RT = 4513.1 LT = 4500.0
 Rad Chem 2
 S1607240-007A

ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY	(keV)
1	606.93 611.75 0.0018 0.0000	3751	3502	64	609.32	1.25	2.00	Bi-214	609.31
2	659.29 664.11 0.0000 0.0000	137	-5	19	661.70	0.22	0.35	Cs-137	661.66
3	724.58 729.84 0.0002 0.0001	223	65	23	727.05	1.44	2.33	Bi-212	727.00
4	765.77 771.02 0.0014 0.0002	483	237	31	768.45	1.30	1.66	Bi-214	768.36
5	823.38 828.64 0.0000 0.0852	142	-29	22	824.26	0.22	0.35	Co-60	826.28
6	843.53 848.79 0.0000 0.0000	114	-15	19	844.19	0.22	0.35	Co-56	846.77
7	857.99 863.25 0.0000 0.0001	167	9	22	858.87	0.22	0.35	Tl-208	860.56
8	908.38 914.07 0.0003 0.0000	370	221	27	911.13	0.98	2.45	Ac-228	911.20
9	966.21 971.90 0.0003 0.0000	246	147	22	969.45	1.26	2.02	Ac-228	968.97
10	998.19 1003.88 0.0039 0.0008	180	94	19	1001.01	0.89	1.74	Pa-234M	1001.03
11	1059.08 1065.21 match!	114	-26	22	1060.17	4.16	4.29	No close library	
12	1117.34 1123.47 0.0018 0.0001	800	665	34	1120.33	1.38	2.54	Bi-214	1120.29
13	1170.34 1176.47 0.0000 0.0000	125	-10	22	1172.31	1.75	1.88	Co-60	1173.24
14	1235.17 1241.30 0.0021 0.0002	376	279	25	1238.14	1.73	2.64	Bi-214	1238.11
15	1269.55 1276.12 match!	109	-10	22	1271.08	0.22	0.35	No close library	
16	1329.34 1335.91 0.0000 0.0000	96	-23	21	1331.31	0.22	0.35	Co-60	1332.50
17	1457.88 1464.45 0.0043 0.0002	1010	896	37	1460.97	1.79	2.72	K-40	1461.00
18	1761.13 1768.13 0.0026 0.0001	674	630	28	1764.70	1.92	3.06	Bi-214	1764.49



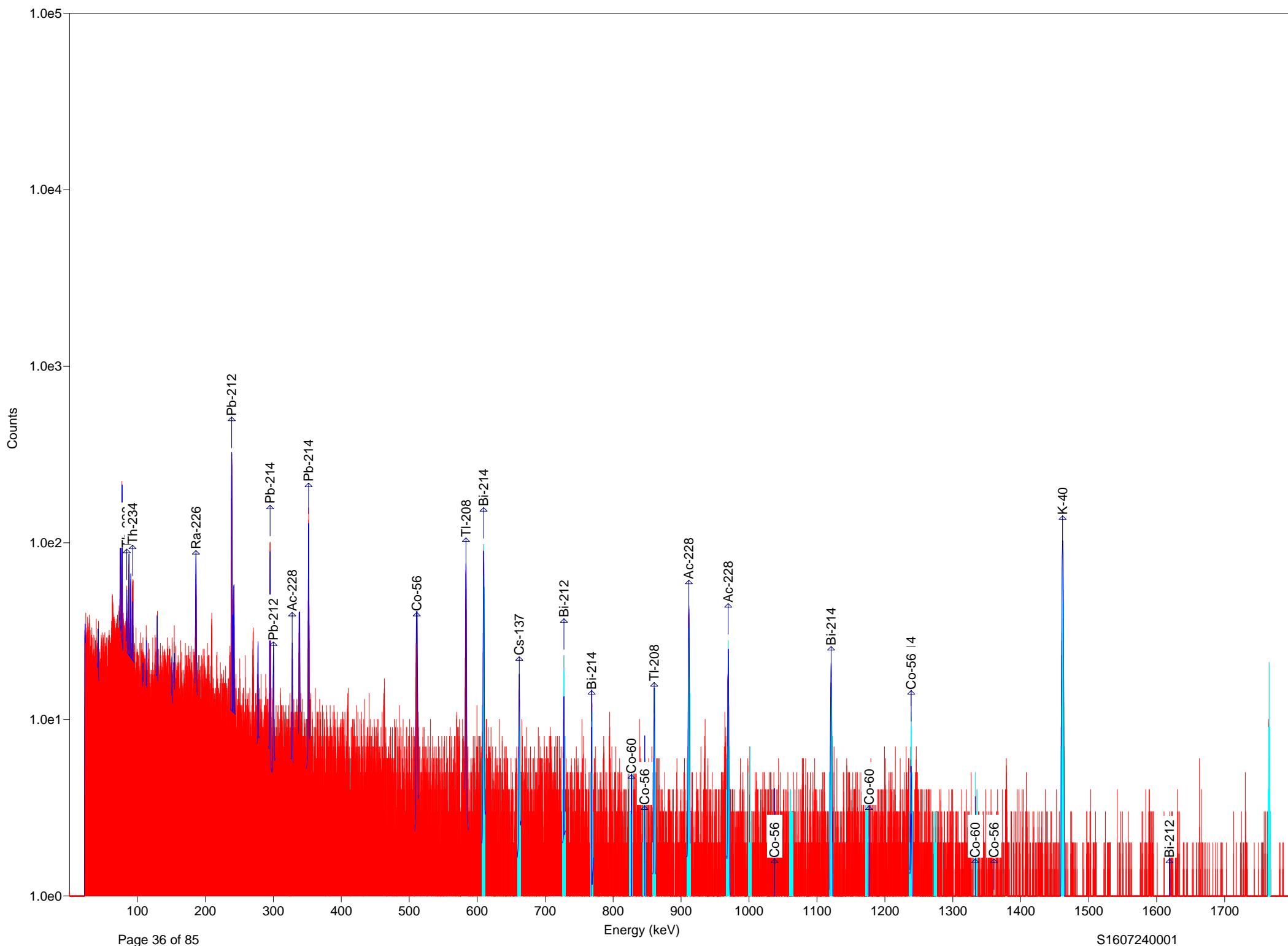
S1607240-008A.Rpt

Detector #2	ACQ	19-Jul-2016 at 10:50:44	RT = 4510.4	LT = 4500.0				
ROI#	RANGE(keV)	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
	µCi +/-							
1	606.93 611.75 0.0002 0.0000	520	416	26	609.31	1.31	1.91	Bi-214 609.31
2	659.29 664.11	75	-32	16	Could not properly fit the peak.			
3	724.58 729.84 0.0004 0.0001	172	114	17	727.43	0.85	2.03	Bi-212 727.00
4	765.77 771.02 0.0000 0.0001	132	7	20	767.85	0.44	0.65	Bi-214 768.36
5	823.38 828.64 0.0852 0.0349	43	22	9	827.76	0.26	0.44	Co-60 826.28
6	843.53 848.79 0.0000 0.0000	74	16	14	845.32	0.87	1.01	Co-56 846.77
7	857.99 863.25 0.0001 0.0000	110	52	15	860.40	0.38	1.47	Tl-208 860.56
8	908.38 914.07 0.0004 0.0000	356	302	22	911.22	1.91	2.52	Ac-228 911.20
9	966.21 971.90 0.0003 0.0000	223	155	19	969.18	0.73	2.45	Ac-228 968.97
10	998.19 1003.88 0.0010 0.0005	69	24	13	1001.47	0.65	0.86	Pa-234M 1001.03
11	1059.08 1065.21 match!	47	3	13	1061.05	0.66	0.79	No close library
12	1117.34 1123.47 0.0003 0.0000	149	110	16	1120.47	1.59	2.42	Bi-214 1120.29
13	1170.34 1176.47 0.0000 0.0000	64	-9	16	1171.97	0.41	0.56	Co-60 1173.24
14	1235.17 1241.30 0.0003 0.0001	94	36	16	1237.12	0.25	0.65	Bi-214 1238.11
15	1269.55 1276.12 match!	58	17	13	1272.50	1.02	1.29	No close library
16	1329.34 1335.91 0.0000 0.0000	36	0	12	1332.95	0.40	0.55	Co-60 1332.50
17	1457.88 1464.45 0.0041 0.0002	912	860	32	1460.92	1.96	2.99	K-40 1461.00
18	1761.13 1768.13 0.0003 0.0001	98	65	14	1764.30	0.64	1.96	Bi-214 1764.49



S1607240-009A.Rpt

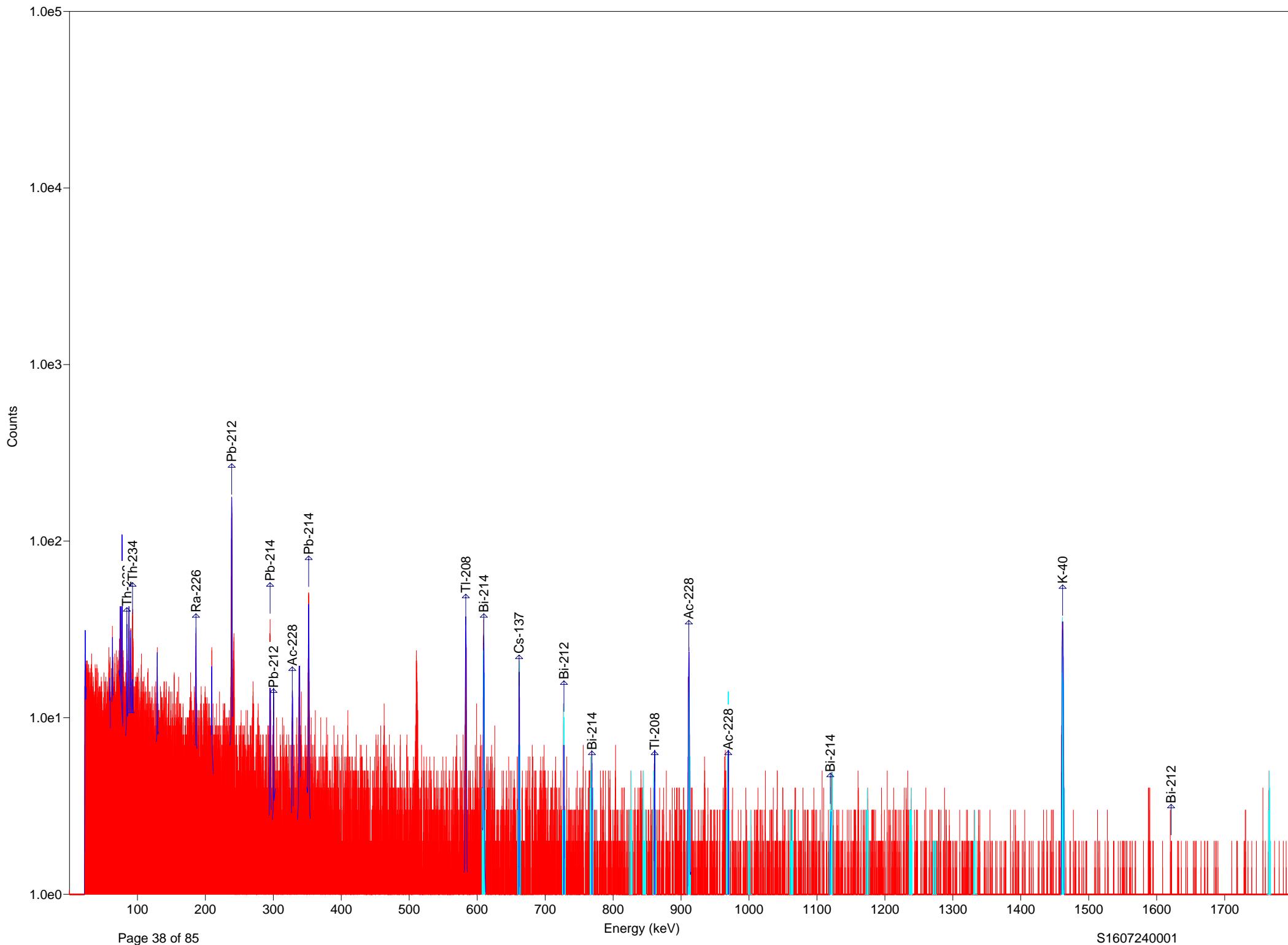
Detector #2	ACQ	19-Jul-2016 at 12:09:02	RT = 4531.8	LT = 4500.0					
Rad	Chem	2							
S1607240-009A									
ROI#	RANGE(keV)	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY	(keV)
	μCi	+/-							
1	606.93 611.75 0.0003 0.0000	642	523	29	609.30	1.25	2.01	Bi-214	609.31
2	659.29 664.11 0.0000 0.0000	144	48	17	661.72	0.87	1.18	Cs-137	661.66
3	724.58 729.84 0.0003 0.0001	167	84	18	727.32	1.06	1.63	Bi-212	727.00
4	765.77 771.02 0.0000 0.0001	124	-1	19	768.18	0.22	0.35	Bi-214	768.36
5	823.38 828.64 0.0077 0.0465	52	2	12	825.35	0.33	1.05	Co-60	826.28
6	843.53 848.79 0.0000 0.0000	71	13	14	846.60	1.35	1.97	Co-56	846.77
7	857.99 863.25 0.0001 0.0000	114	56	15	860.85	0.81	1.40	Tl-208	860.56
8	908.38 914.07 0.0003 0.0000	325	271	21	911.19	1.12	2.14	Ac-228	911.20
9	966.21 971.90 0.0003 0.0000	222	159	19	969.29	0.81	1.97	Ac-228	968.97
10	998.19 1003.88 0.0013 0.0005	66	30	12	1000.56	0.97	2.08	Pa-234M	1001.03
11	1059.08 1065.21 match!	57	-11	15	1059.95	0.22	0.35	No close library	
12	1117.34 1123.47 0.0002 0.0000	153	90	18	1120.27	1.08	1.99	Bi-214	1120.29
13	1170.34 1176.47 0.0000 0.0000	61	-7	15	1172.97	0.27	0.48	Co-60	1173.24
14	1235.17 1241.30 0.0000 0.0000	114	51	17	1239.33	0.22	0.35	Co-56	1238.28
15	1269.55 1276.12 match!	54	18	12	1275.25	0.26	1.53	No close library	
16	1329.34 1335.91 0.0000 0.0000	34	-7	12	1330.54	0.42	0.56	Co-60	1332.50
17	1457.88 1464.45 0.0041 0.0002	913	856	33	1460.83	1.73	2.93	K-40	1461.00
18	1761.13 1768.13 0.0004 0.0000	101	90	11	1764.71	2.17	2.92	Bi-214	1764.49



S1607240-009AD.Rpt

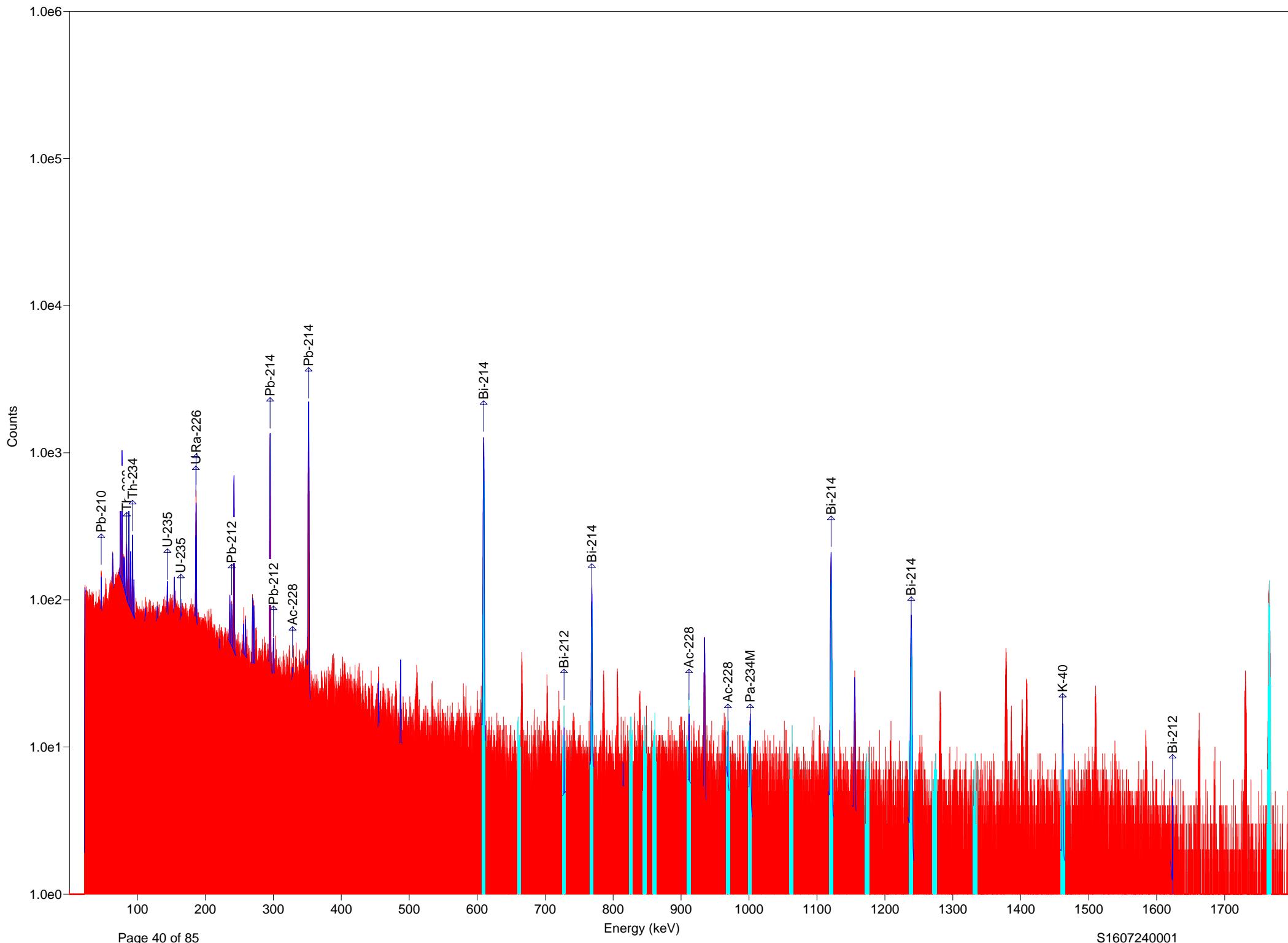
Detector #2 ACQ 19-Jul-2016 at 13:26:44 RT = 4532.0 LT = 4500.0
 Rad Chem 2
 S1607240-009AD

ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
1	606.93 611.75 0.0002 0.0000	613	486	29	609.35	1.28	1.77	Bi-214 609.31
2	659.29 664.11 0.0000 0.0000	148	67	17	661.60	1.01	1.99	Cs-137 661.66
3	724.58 729.84 0.0004 0.0001	158	100	16	727.42	0.37	1.90	Bi-212 727.00
4	765.77 771.02 0.0003 0.0001	128	53	17	768.63	0.34	1.73	Bi-214 768.36
5	823.38 828.64 0.0620 0.0465	58	16	12	827.52	0.26	0.78	Co-60 826.28
6	843.53 848.79 0.0000 0.0000	64	1	14	846.82	0.26	0.44	Co-56 846.77
7	857.99 863.25 0.0002 0.0000	127	69	15	860.68	1.11	1.67	Tl-208 860.56
8	908.38 914.07 0.0003 0.0000	352	266	23	911.17	1.41	2.25	Ac-228 911.20
9	966.21 971.90 0.0003 0.0000	212	135	20	969.03	1.28	1.95	Ac-228 968.97
10	998.19 1003.88 0.0000 0.0007	65	-12	16	1000.81	0.88	1.01	Pa-234M 1001.03
11	1059.08 1065.21 match!	58	-15	16	1060.17	0.77	0.96	No close library
12	1117.34 1123.47 0.0004 0.0000	179	150	16	1120.35	1.82	2.51	Bi-214 1120.29
13	1170.34 1176.47 0.0000 0.0000	50	2	13	1171.22	0.27	0.48	Co-60 1173.24
14	1235.17 1241.30 0.0000 0.0000	106	33	17	1238.40	0.94	1.25	Co-56 1238.28
15	1269.55 1276.12 match!	45	9	12	1271.74	2.96	3.37	No close library
16	1329.34 1335.91 0.0000 0.0000	38	17	10	1332.62	0.22	0.35	Co-60 1332.50
17	1457.88 1464.45 0.0041 0.0002	935	857	34	1461.01	1.91	3.11	K-40 1461.00
18	1761.13 1768.13 0.0004 0.0001	116	105	12	1764.61	0.35	2.13	Bi-214 1764.49



ROCKYFLATS.Rpt

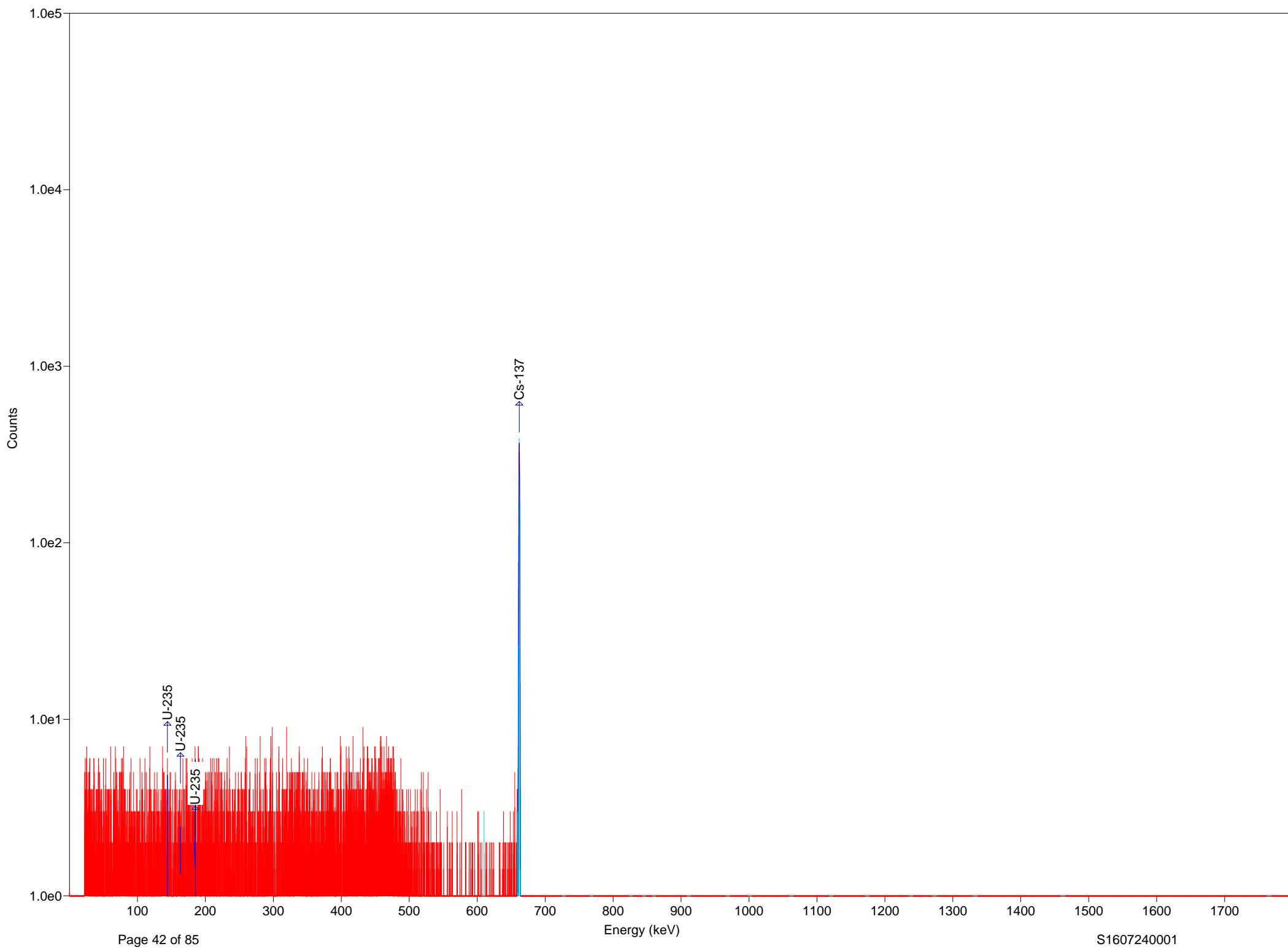
Detector #2	ACQ	19-Jul-2016 at 14:43:35	RT = 4532.5	LT = 4500.0					
Rad	Chem	2							
ROCKYFLATS									
ROI#	RANGE(keV)	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY	(keV)
μCi	+/								
1	606.93 611.75 0.0001 0.0000	240	163	19	609.23	1.09	1.88	Bi-214	609.31
2	659.29 664.11 0.0000 0.0000	131	73	15	661.78	0.86	1.67	Cs-137	661.66
3	724.58 729.84 0.0002 0.0001	90	40	14	726.77	0.44	0.77	Bi-212	727.00
4	765.77 771.02 0.0001 0.0001	60	22	11	768.18	0.25	0.39	Bi-214	768.36
5	823.38 828.64 0.0232 0.0387	39	6	10	826.01	0.22	0.35	Co-60	826.28
6	843.53 848.79	42	-21	13	Could not properly fit the peak.				
7	857.99 863.25 0.0001 0.0000	66	24	12	860.49	0.64	1.18	Tl-208	860.56
8	908.38 914.07 0.0002 0.0000	191	155	16	911.09	1.43	2.22	Ac-228	911.20
9	966.21 971.90 0.0001 0.0000	102	66	13	968.82	1.20	2.19	Ac-228	968.97
10	998.19 1003.88 0.0000 0.0005	33	-3	11	1002.57	0.33	0.53	Pa-234M	1001.03
11	1059.08 1065.21 match!	39	15	10	1060.83	3.94	4.21	No close library	
12	1117.34 1123.47 0.0001 0.0000	67	38	12	1120.76	0.46	1.45	Bi-214	1120.29
13	1170.34 1176.47 0.0000 0.0000	33	-6	11	1173.96	0.41	0.56	Co-60	1173.24
14	1235.17 1241.30 0.0000 0.0000	38	23	8	1238.72	0.78	0.97	Co-56	1238.28
15	1269.55 1276.12	30	-1	11	Could not properly fit the peak.				
16	1329.34 1335.91 0.0000 0.0000	22	1	9	1331.09	0.22	0.35	Co-60	1332.50
17	1457.88 1464.45 0.0015 0.0001	332	311	19	1460.90	1.97	3.12	K-40	1461.00
18	1761.13 1768.13 0.0001 0.0000	35	29	7	1764.32	0.63	2.47	Bi-214	1764.49



UTS-4.Rpt

Detector #2 ACQ 19-Jul-2016 at 16:01:15 RT = 4540.8 LT = 4500.0
 Rad Chem 2
 UTS-4

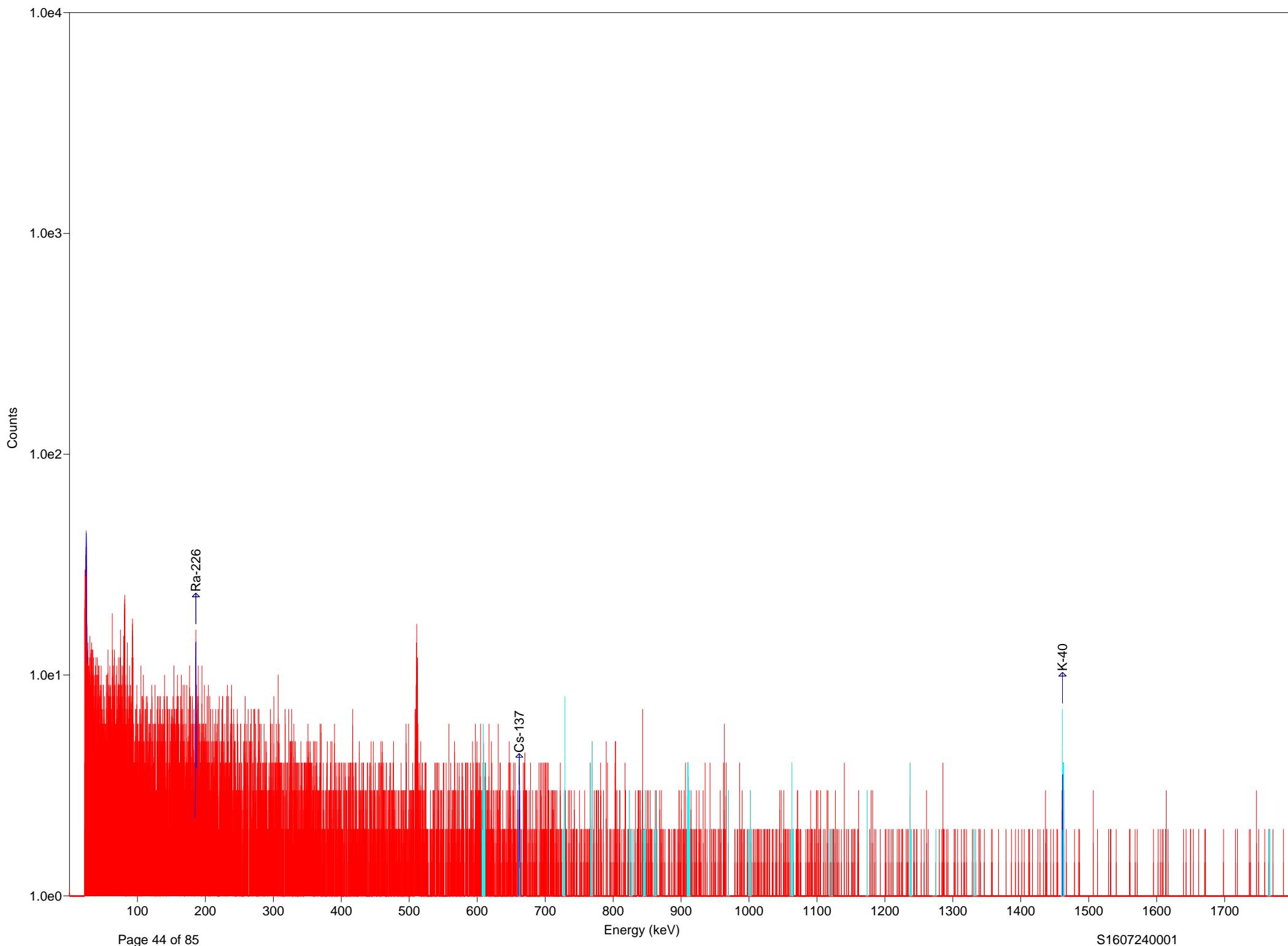
ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY	(keV)
1	606.93 611.75 0.0039 0.0000	7993	7629	93	609.35	1.29	1.99	Bi-214	609.31
2	659.29 664.11 0.0000 0.0000	215	-15	25	659.95	0.22	0.35	Cs-137	661.66
3	724.58 729.84 0.0000 0.0001	214	-11	26	727.65	0.23	0.37	Bi-212	727.00
4	765.77 771.02 0.0041 0.0002	945	707	38	768.40	1.35	2.17	Bi-214	768.36
5	823.38 828.64 0.1085 0.0891	195	28	23	826.45	0.22	0.35	Co-60	826.28
6	843.53 848.79 0.0000 0.0000	210	-44	27	845.94	0.24	0.39	Co-56	846.77
7	857.99 863.25 0.0000 0.0001	224	-26	27	861.32	0.28	0.50	Tl-208	860.56
8	908.38 914.07 0.0001 0.0000	264	61	27	910.99	0.35	1.11	Ac-228	911.20
9	966.21 971.90 0.0000 0.0001	223	11	27	969.51	0.26	0.46	Ac-228	968.97
10	998.19 1003.88 0.0026 0.0010	234	63	25	1002.16	0.33	2.40	Pa-234M	1001.03
11	1059.08 1065.21 match!	150	10	23	1062.99	0.31	0.54	No close library	
12	1117.34 1123.47 0.0040 0.0001	1736	1528	48	1120.42	1.67	2.64	Bi-214	1120.29
13	1170.34 1176.47 0.0000 0.0000	136	15	21	1171.47	1.31	1.44	Co-60	1173.24
14	1235.17 1241.30 0.0003 0.0000	694	534	33	1238.20	2.01	2.67	Co-56	1238.28
15	1269.55 1276.12 match!	153	3	25	1274.37	0.26	0.88	No close library	
16	1329.34 1335.91 0.0000 0.0000	120	-20	23	1332.40	0.22	0.35	Co-60	1332.50
17	1457.88 1464.45 0.0005 0.0001	179	101	20	1460.76	1.37	2.75	K-40	1461.00
18	1761.13 1768.13 0.0055 0.0002	1346	1313	38	1764.64	2.05	3.06	Bi-214	1764.49



CS-137.Rpt

Detector #2 ACQ 18-Jul-2016 at 11:29:12 RT = 90.2 LT = 89.7
 Rad Chem 2
 CS-137 START CAL

ROI#	RANGE(keV)	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY	(keV)
	μCi	+/							
1	606.93	611.75	10	-2	5	609.78	0.22	0.35	Bi-214 609.31
0.0000	0.0001								
2	659.29	664.11	2309	2267	48	661.69	1.27	2.04	Cs-137 661.66
0.0325	0.0007								
3	724.58	729.84	0	0	0	Could not properly fit the peak.			
4	765.77	771.02	0	0	0	Could not properly fit the peak.			
5	823.38	828.64	1	1	1	Could not properly fit the peak.			
6	843.53	848.79	0	0	0	Could not properly fit the peak.			
7	857.99	863.25	1	1	1	Could not properly fit the peak.			
8	908.38	914.07	0	0	0	Could not properly fit the peak.			
9	966.21	971.90	2	2	1	Could not properly fit the peak.			
10	998.19	1003.88	0	0	0	Could not properly fit the peak.			
11	1059.08	1065.21	0	0	0	Could not properly fit the peak.			
12	1117.34	1123.47	0	0	0	Could not properly fit the peak.			
13	1170.34	1176.47	0	0	0	Could not properly fit the peak.			
14	1235.17	1241.30	0	0	0	Could not properly fit the peak.			
15	1269.55	1276.12	0	0	0	Could not properly fit the peak.			
16	1329.34	1335.91	0	0	0	Could not properly fit the peak.			
17	1457.88	1464.45	0	0	0	Could not properly fit the peak.			
18	1761.13	1768.13	0	0	0	Could not properly fit the peak.			



BACKGROUND.Rpt

Detector #2 ACQ 19-Jul-2016 at 17:18:40 RT = 4532.5 LT = 4500.0
 Rad Chem 2
 BACKGROUND

ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
1	606.93 611.75 0.0000 0.0000	52	17	10	608.90	0.44	0.92	Bi-214 609.31
2	659.29 664.11 0.0000 0.0000	32	9	8	662.02	0.88	1.14	Cs-137 661.66
3	724.58 729.84 0.0000 0.0000	31	10	8	728.74	0.22	0.35	Bi-212 727.00
4	765.77 771.02 0.0000 0.0000	24	-1	8	769.05	0.22	0.35	Bi-214 768.36
5	823.38 828.64	25	-4	9	Could not properly fit the peak.			
6	843.53 848.79 0.0000 0.0000	30	1	9	847.26	0.22	0.35	Co-56 846.77
7	857.99 863.25 0.0000 0.0000	21	-4	8	861.94	0.22	0.35	Tl-208 860.56
8	908.38 914.07 0.0000 0.0000	38	11	10	909.25	1.75	1.99	Ac-228 911.20
9	966.21 971.90 0.0000 0.0000	9	9	3	969.49	0.27	1.14	Ac-228 968.97
10	998.19 1003.88 0.0000 0.0003	17	-6	8	1001.69	0.22	0.35	Pa-234M 1001.03
11	1059.08 1065.21 match!	21	-3	9	1062.58	0.22	0.35	No close library
12	1117.34 1123.47	19	-5	9	Could not properly fit the peak.			
13	1170.34 1176.47 0.0000 0.0000	12	2	6	1173.63	0.22	0.35	Co-60 1173.24
14	1235.17 1241.30 0.0001 0.0000	18	8	6	1236.74	0.32	0.96	Bi-214 1238.11
15	1269.55 1276.12 match!	12	-4	7	1274.59	0.33	0.53	No close library
16	1329.34 1335.91 0.0000 0.0000	13	-3	7	1330.43	0.22	0.35	Co-60 1332.50
17	1457.88 1464.45 0.0002 0.0000	44	39	7	1460.68	0.28	1.32	K-40 1461.00
18	1761.13 1768.13 0.0001 0.0000	15	15	3	1764.19	2.08	2.28	Bi-214 1764.49

Table B-17 – Results of Dixon r tests applied to laboratory mean results

Material	Isotope	Set	No. sets	Test ratio	Critical	Value, r**
					P = 10%	P = 5%
UTS-1	^{210}Pb	Lab-7	7	.63	.51	.57
UTS-1	^{228}Ra	Lab-5*	4	.90	.77	.82
UTS-2	^{210}Pb	Lab-7	7	.63	.51	.57
UTS-4	^{230}Th	Lab-3	7	.71	.51	.57

*Test result overruled; set means of the other three sets were judged to be fortuitously close.

**Relevant probabilities are twice values for predesignated end of the set values (B2).

Table B-18 – Consensus values and related statistical parameters for isotope activities in tailings reference materials

Isotope	Consensus value, [CL], Bq g^{-1} ^a (No. sets, No. values, RSD (%), CV(%))			
	UTS-1	UTS-2	UTS-3	UTS-4
^{230}Th	3.6 [3.0 – 4.2] (7,28,21,10)	4.4 [3.3 – 5.5] (2,79,26,24)	11.3 [10.5 – 12.1] (7,29,9,5)	22.9 ^b [20.3 – 25.5] (6,24,13,7)
^{226}Ra	3.67 [3.52 – 3.82] (8,31,9,7)	5.6 [6.2 – 6.0] (8,37,13,8)	13.3 [12.7 – 13.9] (8,30,11,6)	38.6 [36.2 – 40.9] (6,33,9,5)
^{210}Pb	3.25 ^b [3.03 – 3.47] (6,23,9,7)	4.55 ^b [4.36 – 4.75] (6,39,12,9)	12.6 [12.1 – 13.2] (7,30,9,7)	32.4 [29.6 – 35.3] (7,26,9,4)
^{210}Po	3.1 [2.7 – 3.5] (6,27,10,4)	4.4 [3.7 – 5.1] (6,29,14,6)	11.8 [10.8 – 12.9] (6,29,8,4)	30.8 [25.8 – 35.9] (6,28,14,4)
$^{232}\text{Th}^{\text{c},\text{d}}$	.68 [.59 – .77] (5,18,16,11)	.88 [.67 – 1.08] (5,19,24,17)	(.16 ± .04)	(.48 ± .06)
^{228}Ra	.68 [.47 – .89] (4,14,19,10)	1.0 [0.7 – 1.4] (4,15,17,6)	–	–
$^{228}\text{Th}^{\text{d}}$	.71 [.58 – .84] (5,20,21,13)	.92 [.58 – 1.25] (5,21,29,11)	(.16 ± .04)	(.23 ± .04)
$^{231}\text{Pa}^{\text{d}}$	(.21 ± .03)	(.37 ± .05)	(.70 ± 1.0)	(2.4 ± .3)

a. CL = statistical uncertainty range at 95% confidence level, RSD = relative standard deviation of individual results (%), CV = average within-laboratory rel. std. dev. (%).

b. Data are exclusive of an outlying set.

c. ^{232}Th results from alpha spectrometry only. ^{232}Th concs. by NAA are incorporated with chemical results.

d. Single laboratory results and uncertainty estimates in brackets are for information only.



National Institute of Standards & Technology Certificate

Standard Reference Material® 4353A

Rocky Flats Soil Number 2

This Standard Reference Material (SRM) has been developed in cooperation with member laboratories of the International Committee for Radionuclide Metrology and other experienced metrology laboratories. The SRM consists of approximately 90 grams of air-dried, pulverized soil in a polyethylene bottle. The SRM is intended: for use in tests of measurements of radioactivity contained in matrices similar to the sample, for evaluating analytical methods, and as a generally available calibrated "real" sample matrix for laboratory intercomparison.

Radiological Hazards: This SRM contains low levels of anthropogenic and natural radioactivity and poses no radiological hazard. The SRM should be used only by qualified persons.

Chemical Hazards: The SRM is a dried sterilized soil and poses no chemical or biological hazard. However, inhalation or ingestion of the material should be avoided.

Storage and Handling: The SRM should be stored in a dry location at room temperature. The bottle should be shaken before opening in a chemical hood and should be recapped tightly as soon as subsamples are removed. The bottle (or any subsequent container) should always be clearly marked. If the SRM is transported, it should be packed, marked, labeled, and shipped in accordance with applicable national, international, and carrier regulations.

Preparation: This Standard Reference Material was prepared under the leadership of the Physics Laboratory, Ionizing Radiation Division, Radioactivity Group, Michael Unterweger, Acting Group Leader. The overall technical direction leading to the certification of this SRM was provided by Svetlana Nour and Kenneth G.W. Inn of the Radioactivity Group.

Statistical support was provided by James J. Filliben of the Information Technology Laboratory, Statistical Engineering Division.

The support aspects involved in the preparation, certification, and issuance of this SRM were coordinated through the NIST Measurement Services Division.

Technical Contacts: Svetlana Nour (e-mail: svetlana.nour@nist.gov; phone: 1-301-975-4927) and Kenneth G.W. Inn (e-mail: kenneth.inn@nist.gov; phone: 1-301-975-5541), NIST, Building 245, Room C114, Gaithersburg, MD 20899-8462, fax 1-301-926-7416.

Lisa Karam, Deputy Chief
Ionizing Radiation Division

Robert L. Watters, Jr., Chief
Measurement Services Division

Gaithersburg, Maryland 20899
July 2007

Details of the SRM preparation: This SRM is from the Rocky Flats Plant in north-central Colorado. The material was obtained from Rockwell International's Rocky Flats Plant (RFP) by the National Institute of Standards and Technology (NIST) of the U.S. Departments of Commerce and by the Environmental Measurements Laboratory (EML) of the U.S. Department of Homeland Security. The material was first coarsely sieved in the field to remove rocks larger than about 1.5 cm diameter. After air drying, the soil was blade milled twice. The soil was pulverized with a "pancake" style air jet mill to an average particle diameter of 8 μm . More than 99 percent, by weight, of the particles are less than 20 μm in diameter. The SRM was "V-cone" blended to optimize homogeneity and bottled in polyethylene bottles. The final bottled SRM was sterilized with > 50 kGy of ^{60}Co radiation to satisfy export regulations and to increase shelf-life time.

Instructions for Drying: When nonvolatile radionuclides are to be determined, working samples of this SRM should be dried at 40°C for 24 hours prior to weighing. Volatile radionuclides (e.g., ^{210}Po , ^{137}Cs , ^{210}Pb , ^{212}Pb and ^{214}Pb) should be determined on samples as received. Separate samples should be dried as previously described to obtain a correction factor for moisture. Correction for moisture content is to be made to the data for volatile radionuclides before comparing with the values given by this certificate. This procedure ensures that these radionuclides are not lost during drying (see Reference [1]*). The weight loss on drying is typically less than 4 percent.

Heterogeneity: Twenty-three bottles of the SRM were examined for gamma-ray heterogeneity by measuring their emission rates by counting them on a "5-in" (12.7 cm) NaI(Tl) detector coupled to a multichannel analyzer. The count rates from each measurement were analyzed for statistical difference for ten selected energy regions, and no detectable heterogeneity was observed.

This material has also been measured for alpha-particle emitting radionuclides using sample sizes of 1 gram to 100 grams. There are variations of results due to sample size. Based on over 100 plutonium and ^{241}Am measurements it was concluded that the material contains "hot" particles, and it is recommended that a sample size of 5 grams to 10 grams be used for radiochemical analysis and a sample size of 30 grams to 100 grams for gamma isotopic analysis. Statement of uncertainties, tolerance limits, and ranges of reported results incorporate the effects of heterogeneity.

Material Stability and Changes in Certified Values: This matrix is considered to be stable; however, its stability has not been rigorously assessed. NIST will monitor this material and will report any substantive changes in certification to the purchaser. Return of the enclosed registration card is mandatory to receive such notifications. The properties of the SRM are given in Table 1.

Calculation of Certified Massic Activity Values: The certified massic activity value for each nuclide (see Tables 2, 3 and 4) was determined from the evaluated average of the individual laboratory means. This approach was selected because of the well-behaved normal distribution of the laboratories' data.

Calculation of the Uncertainties for the Certified Values: The standard combined uncertainties (u_c) for each of the certified values were computed by incorporating components from three sources: 1) the estimated standard deviation of the mean of the laboratory mean values, 2) the $k = 1$ uncertainty associated with the radiochemical tracer SRMs, and 3) Type B scientific judgment. The uncertainty components were combined in quadrature as specified by the GUM. The expanded uncertainties (U) were computed using the Welch-Satterthwaite coverage factor. The expanded uncertainty (U) is taken as the 95 percent confidence interval.

Calculation of Certified Tolerance Limits: In addition to the certified massic activities and activity ratios, and their respective uncertainty values, Tables 2, 3, and 4 also provide 95/95 (normal) tolerance limits. Whereas the certified value is the mean of the population of measurements of the SRM and the expanded uncertainty for the certified value is at the 95 percent confidence limit, the tolerance limits are a measure of the spread of the population of measurements across the SRM. A 95/95 tolerance limit means that NIST is 95% confident that 95% of the population of SRM measurements fall within the specified limits. The tolerance limits are used when the number of replicates is small ($n < 5$), e.g., when the material is used as a periodic QC sample. For guidance on the use of tolerance limits in connection with this SRM, see Appendix 1.

Uncertified Massic Activities and Mass Ratios: The massic activities and mass ratios for the radionuclides given in Table 5 and 6 are not certified at this time, but may be certified at some future time if additional data become available. Users are invited to submit measurement data to contribute to the certification process. The data should be sent to one of the technical contacts listed on page 1.

Elemental Composition: Semi-quantitative elemental analysis of the Rocky Flats Number 2 matrix is listed in Table 8.

Table 1: Properties of SRM 4353A.

Certified Properties	
Radionuclides	See Table 2, 3 and 4
Reference time	1 April 1998
Certified massic activities	See Table 2, and 3
Certified activity ratios	See Table 4
Uncertainties (See Note 1)*	See Table 2, 3 and 4
Tolerance Limits	See Table 2, 3 and 4

Uncertified Properties

Source description	Rocky Flats Soil Number 2, approximately 90 g in a polyethylene bottle
Uncertified massic activities	See Table 5
Uncertified activity ratios	See Table 6
Range of reported values	See Tables 5 and 6
Half-lives used	See Table 7
Radiochemical and detection methods	See Table 7 and 9
Elemental composition	See Table 8
Participating laboratories and personnel	See Table 7 and 10

Table 2: Certified Massic Activities.[†]

Radionuclide	Massic Activity and uncertainty (mBq·g ⁻¹) (See Note 2)*	95/95 Tolerance Limit (mBq·g ⁻¹) (See Note 3)
²³⁸ Pu	0.278 ± 0.041	0.18 to 0.51
^{239,240} Pu	16.8 ± 1.8	6.0 to 26.8
²³⁸ U	39.6 ± 3.0	31.9 to 48.1
²³⁴ U	40.4 ± 3.0	33.7 to 47.7
²³⁵ U	1.88 ± 0.53	0.82 to 2.68
⁹⁰ Sr	10.5 ± 1.3	6.5 to 15.1

[†] Recommended sample size of at least 5 grams for radiochemical analysis. Refer to table 7 for uncertified information.

Table 3: Certified Massic Activities.[‡]

Radionuclide	Massic Activity and uncertainty (mBq·g ⁻¹) (See Note 2)	95/95 Tolerance Limit (mBq·g ⁻¹) (See Note 3)
¹³⁷ Cs	21.6 ± 2.6	13.7 to 30.0
²²⁸ Ra (See Note 4)	74.9 ± 7.5	61.4 to 91.6
²¹⁰ Pb	58.0 ± 9.9	41.8 to 79.7

[‡] Recommended sample size of at least 30 grams for gamma-ray measurement. Refer to table 7 for uncertified information.

Table 4: Certified Activity Ratios.[†]

Radionuclides Ratio	Ratio and uncertainty	95/95 Tolerance Limit (See Note 3)
²³⁴ U / ²³⁸ U	1.028 ± 0.036	0.92 to 1.14
²³⁸ Pu / (²³⁹ Pu+ ²⁴⁰ Pu)	0.017 ± 0.001	0.013 to 0.020
²²⁸ Th / ²³² Th	1.01 ± 0.10	0.84 to 1.14
²³⁰ Th / ²³² Th	0.671 ± 0.067	0.55 to 0.76

[†] Refer to table 7 for uncertified information.

Table 5: Uncertified Massic Activities.[†]

Radionuclide	Massic Activity (mBq·g⁻¹)	Lower and Upper Values of Reported Results (mBq·g⁻¹)
²²⁸ Th	72.4	61.6 to 88.4
²³⁰ Th	47.9	40.9 to 57.8
²³² Th	73.6	62.1 to 90.2
²³⁴ Th	60.1	28.9 to 103.3
²²⁶ Ra	42.4	28.4 to 52.7
²¹⁴ Pb	43.2	34.9 to 51.9
²¹⁴ Bi	40.6	28.4 to 53.2
²¹² Pb	90.2	83.3 to 95.7
²¹² Bi	79.5	68.8 to 87.3
²⁰⁸ Tl	51.3	26.8 to 67.7
⁴⁰ K	589	533 to 719
²⁴¹ Pu	17.0	13.0 to 30.0
²⁴¹ Am (alpha spectrometry)	2.5	0.6 to 5.4
²⁴¹ Am (gamma spectrometry)	4.7	3.7 to 6.6

[†] Radionuclides for which insufficient numbers of data sets or for which unresolved discrepant data sets were obtained. No uncertainties are provided because no meaningful estimates could be made. Refer to table 7 for uncertified information.

Table 6: Uncertified Mass Ratios.[‡]

Radionuclides	Mass Ratio	Lower and Upper Values of Reported Results
²⁴⁰ Pu / ²³⁹ Pu	$5.6 \cdot 10^{-2}$	$(5.3 \text{ to } 6.0) \cdot 10^{-2}$
²⁴¹ Pu / ²³⁹ Pu	$5.8 \cdot 10^{-4}$	$(0.4 \text{ to } 1.3) \cdot 10^{-3}$
²⁴¹ Pu / ²⁴⁰ Pu	$1.0 \cdot 10^{-2}$	$(0.8 \text{ to } 2.3) \cdot 10^{-2}$

[‡] Ratios for which insufficient numbers of data sets or for which unresolved discrepant data sets were obtained. No uncertainties are provided because no meaningful estimate could be made. Refer to table 7 for uncertified information.

Table 7: Uncertified Information for Tables 2 through 6.

Radionuclides	Number of Laboratories (and total assays)	Half Life (See Note 5)*	Methods (Table 9)	Contributing Laboratories Acronym (Table 10)
^{238}Pu	14 (169)	(87.7 ± 0.1) a	2b, 3b	BIL-GSL, CEMRC, EML, FSU, GSF, IAEA, LANL, NIST, OSU, RESL, SRNL, WHOI
$^{239,240}\text{Pu}$	14 (172)	(24110 ± 30) a (6561 ± 7) a	2b, 3b	BIL-GSL, CEMRC, EML, FSU, GSF, IAEA, LANL, NIST, OSU, RESL, SRNL, WHOI
^{238}U	7 (72)	$(4.468 \pm 0.003) 10^9$ a	2b, 3b, 3 e	CEMRC, EML, FSU, NIST, RESL, SRNL,
^{234}U	7 (72)	$(2.455 \pm 0.006) 10^5$ a	2b, 3b	CEMRC, EML, FSU, NIST, RESL, SRNL,
^{235}U	4 (38)	$(7.04 \pm 0.01) 10^8$ a	2b, 3b	CEMRC, EML, NIST, SRNL,
^{90}Sr	5 (38)	(28.79 ± 0.06) a	2c, 3c	EML, IAEA, RESL, WHOI
^{137}Cs	9 (82)	(30.07 ± 0.03) a	1a	BIL-GSL, EML, FSU, LANL, NIST, OSU, RESL, SRNL, WHOI
^{228}Ra (Note 4)	5 (42)	(5.75 ± 0.03) a	1a	BIL-GSL, FSU, NIST, RESL, SRNL
^{210}Pb	3 (24)	(22.20 ± 0.22) a	1a	FSU, NIST, SRNL
$^{234}\text{U} / ^{238}\text{U}$	8 (87)	$(2.455 \pm 0.006) 10^5$ a $(4.468 \pm 0.003) 10^9$ a	2b, 2e	BIL-GSL, CEMRC, EML, FSU, NIST, RESL, SRNL
$^{238}\text{Pu} / (^{239}\text{Pu} + ^{240}\text{Pu})$	14 (169)	(87.7 ± 0.1) a (24110 ± 30) a (6561 ± 7) a	2b	BIL-GSL, CEMRC, EML, FSU, GSF, IAEA, LANL, NIST, OSU, RESL, SRNL, WHOI,
$^{228}\text{Th} / ^{232}\text{Th}$	3 (27)	(1.9116 ± 0.0016) a $(1.40 \pm 0.01) 10^{10}$ a	2b	CEMRC, NIST, RESL
$^{230}\text{Th} / ^{232}\text{Th}$	3 (27)	$(7.538 \pm 0.030) 10^4$ a $(1.40 \pm 0.01) 10^{10}$ a	2b	CEMRC, NIST, RESL
^{228}Th	3 (27)	(1.9116 ± 0.0016) a	2b, 3b	CEMRC, NIST, RESL
^{230}Th	3 (27)	$(7.538 \pm 0.030) 10^4$ a	2b, 3b	CEMRC, NIST, RESL
^{232}Th	4 (42)	$(1.40 \pm 0.01) 10^{10}$ a	2b, 3b, 3 e	CEMRC, IAEA, NIST, RESL
^{234}Th	2 (21)	(24.10 ± 0.03) d	1a	FSU, SRNL
^{226}Ra	4 (38)	(1600 ± 7) a	1a	BIL-GSL, FSU, RESL, SRNL
^{214}Pb	3 (21)	(26.8 ± 0.9) min	1a	BIL-GSL, FSU, SRNL
^{214}Bi	3 (32)	(19.9 ± 0.4) min	1a	BIL-GSL, FSU, SRNL
^{212}Pb	1 (15)	(10.64 ± 0.01) h	1a	SRNL
^{212}Bi	1 (15)	(60.55 ± 0.06) min	1a	SRNL
^{208}Tl	3 (33)	(3.053 ± 0.004) min	1a	BIL-GSL, FSU, SRNL
^{40}K	2 (30)	$(1.248 \pm 0.003) 10^9$ a	1a	BIL-GSL, SRNL
^{241}Pu	2 (20)	(14.290 ± 0.006) a	2d	IAEA
$^{241}\text{Am} (\alpha \text{ spectrometry})$	13 (115)	(432.6 ± 0.6) a	2b, 3b	BIL-GSL, CEMRC, EML, FSU, IAEA, LANL, NIST, OSU, RESL, SRNL, WHOI

Table 7 (cont.): Uncertified Information for Tables 2 through 6.

Radionuclides	Number of Laboratories (and total assays)	Half Life (See Note 5)*	Methods (Table 9)	Contributing Laboratories Acronym (Table 10)
^{241}Am (γ spectrometry)	3 (24)	(432.6 ± 0.6) a	1a	FSU, NIST, SRNL
$^{240}\text{Pu} / ^{239}\text{Pu}$	1 (15)	(24110 ± 30) a (6561 ± 7) a	2e	SRNL
$^{241}\text{Pu} / ^{239}\text{Pu}$	1 (15)	(14.290 ± 0.006) a (6561 ± 7) a	2e	SRNL
$^{241}\text{Pu} / ^{240}\text{Pu}$	1 (15)	(14.290 ± 0.006) a (24110 ± 30) a	2e	SRNL

Table 8: Elemental Composition Based on Semi-quantitative X-Ray Fluorescence (XRF) analysis[†]. These values are not certified.

Element	Percent by mass (%)	Element	Percent by mass (%)
Si	36	Cl	0.004
Al	4.5	Cr	0.033
Fe	2.6	Cu	0.003
Mg	0.29	Ga	<0.001
Ca	0.40	Ni	0.018
Na	0.65	Pb	0.003
K	1.7	Rb	0.007
Ti	0.20	Sr	0.011
P	0.07	V	0.004
Mn	0.054	Y	0.002
C	1.5	Zn	0.007
S	0.02	Zr	0.02

[†]The estimated relative combined standard uncertainty for each reported concentration is from -33 % to +50 %. Data presented by John Sieber, Chemical Science and Technology Laboratory (CSTL).

Table 9: Radiochemical and Detection Methods.

1	Non-destructive
2	Fusion/total decomposition
3	Acid leach (any combination of the following HNO_3 , HCl , HF , HClO_4)
a	Germanium gamma-ray spectrometer
b	Silicon surface-barrier alpha-particle spectrometer
c	Beta-particle counter
d	Liquid scintillation counter
e	Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS), Atomic Mass Spectroscopy (AMS)

Table 10: Participating Laboratories and Personnel.

Laboratory Acronym	Laboratory	Country	Technical Contact
BIL - GSL	British Nuclear Group Sellafield Ltd.	United Kingdom	Dr. M. Froggatt
CEMRC	Carlsbad Environmental Monitoring & Research Center	United States of America	Dr. B. Stewart
EML	Environmental Measurements Laboratory	United States of America	Dr. H. Volchok, M. Feiner
FSU	Florida State University	United States of America	Dr. W. Burnett
GSF	National Research Center for Environment and Health, Institute of Radiation Protection	Germany	Dr. K. Bunzl
IAEA †	International Atomic Energy Agency	Austria	Dr. J. Moreno, Dr. K. Burns, Dr. G. Kis-Benedek
LANL	Los Alamos National Laboratory	United States of America	Dr. D. Decker, Dr. N. Koski, Dr. S.R. Garcia
NIST	National Institute of Standards and Technology	United States of America	S. Nour, Dr. K. Inn
OSU	Oregon State University	United States of America	Dr. T. Beasley
RESL †	Radiological and Environmental Sciences Laboratory (RESL)	United States of America	Dr. D. Olson , Dr. S. Bohrer
SRNL	Savannah River National Laboratory	United States of America	J. Cadieux
WHOI	Woods Hole Oceanographic Institution	United States of America	Dr. V. Bowen, Dr. H. Livingston

† Note: These laboratories participated twice, reporting two sets of data.

Appendix 1

Recommendations on the use of the certified values for validation of measurements or methods

Case 1. Single Observation

Recommendation.

If a single observation is made, check to see if that value is within the certified 95/95 (95% confidence / 95% coverage) tolerance interval as provided in column 3 of Tables 2, 3, and 4 . If yes, then conclude that the measurement/method process is acceptable; if no, then conclude that the process is questionable and adjust accordingly.

Example.

A laboratory analyzed ^{235}U with a single measurement of this SRM to validate its method. The measured result was 1.86 mBq/g. The NIST certified value (see column 2 of Table 2) is 1.88 mBq/g. Is the laboratory method valid?

Procedure.

Check to determine if the measured value 1.86 is within the tolerance interval as provided in column 3 of Table 2. The tolerance interval for ^{235}U is (0.82, 2.68). Since 1.86 falls within this interval, then conclude that no evidence exists that this process is invalid (that is, in practice, we conclude that the process is valid).

Case 2. Multiple Observations

Recommendation.

If multiple observations are made, then:

1. check that at least 95% of the data points are within the provided tolerance interval (if yes, then accept the process; otherwise, reject the process);
2. check (via the appropriate t-test) that the mean of the collected data points is "close enough" to the provided certified value.

Example.

A laboratory analyzed ^{235}U in 5 replicates of this SRM to validate its method. The analytical results were 1.86, 1.99, 1.85, 1.87, and 1.86 mBq/g. The NIST certified value is 1.88 mBq/g. Is the laboratory method valid?

Procedure.

1. Check to determine the proportion of the 5 measured values that are within the 95/95 tolerance interval (0.82, 2.68) as provided in column 3 of Table 2 (at least 95% of the 5 values should fall within). Since 5 out of 5 of the values fall within the interval, then we conclude that the process is valid.
- 2: Compare the mean of the 5 collected points (1.866) with the certified value (1.88) by performing the t-test .

2.1. NIST's Certified Value:

$$m = 1.88 \text{ mBq/g (see Table 2)}$$

2.2. Compute Laboratory Data Summary Statistics:

Sample size	$n = 5$
Sample mean	$x = 1.866 \text{ mBq/g}$
Sample standard deviation	$s = 0.015 \text{ mBq/g}$
Significant level of the t-test	$\alpha = 0.05$

2.3. Compute t-test Statistic Value:

$$\begin{aligned} \text{t-test statistic value} &= (x - m)/(s/(n)^{1/2}) \\ &= (1.866 - 1.88)/(0.015/(5)^{1/2}) \\ &= -2.064 \end{aligned}$$

2.4. Determine Cutoff Values for 95 % Confidence:

Upper 2.5% point of $t_{(n-1)}$ distribution = 2.776 (See Table A1)
 Lower 2.5% point of $t_{(n-1)}$ distribution = -2.776 (See Table A1)

3. Conclusions:

- 3.1 If test statistic value < lower cutoff value, then conclude method is invalid with negative bias relative to the certified value.
- 3.2 If test statistic value > upper cutoff value, then conclude method is invalid with positive bias relative to the certified value.
- 3.3 If neither of the above, then conclude method is valid.

Example's Conclusion:

Since the laboratory's test statistic value of -2.064 is neither > the upper cutoff value of 2.776 nor < the lower cutoff value of -2.776, case 3 applies and it can be concluded that the laboratory's method for ^{235}U analysis is valid.

Table A1: Probability points of the t distribution with (n-1) degrees of freedom.

Degrees of freedom (n-1)	Tail area probability, $t_{(n-1)}$ (cutoff values)	
	Upper 2.5 %	Lower 2.5 %
1	12.706	-12.706
2	4.303	-4.303
3	3.182	-3.182
4	2.776	-2.776
5	2.571	-2.571
6	2.447	-2.447
7	2.365	-2.365
8	2.306	-2.306
9	2.262	-2.262
10	2.228	-2.228

NOTES FOR TABLES 1, 2, 3 AND 7

- Note 1. For further information on the expression of uncertainties, see references [3] and [4].
- Note 2. The mean is the evaluated reference value from measurement results by the participating laboratories. The stated uncertainty is the 95% confidence interval based on a student-t distribution.
- Note 3. The tolerance limits are for 95 percent confidence and 95 percent coverage. Differences between laboratories have been eliminated so that the given limits reflect only between-measurement differences.
- Note 4. Radium-228 activity values are based on measurements of its ^{228}Ac daughter.
- Note 5. The stated uncertainty of the half-life is the standard uncertainty. See reference [5].

REFERENCES

- [1] R. Bock, *A Handbook of Decomposition Methods in Analytical Chemistry*, International Textbook Company, Limited. T. & A. Constable Ltd., Great Britain, 1979.
- [2] M. G. Natrella, Experimental Statistics, Handbook 91, 1963, United States Department of Commerce National Bureau of Standards
- [3] International Organization for Standardization (ISO), *Guide to the Expression of Uncertainty in Measurement*, 1993. Available from the American National Standards Institute, 11 West 42nd street, New York, NY 10036, USA. 1-212-642-4900. (Listed under ISO miscellaneous publications as "ISO Guide to the Expression 1993".)
- [4] B.N. Taylor and C.E.Kuyatt, *Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results*, NIST Technical Note 1297, 1994. Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402, USA.
- [5] Evaluated Nuclear Structure Data File (ENSDF), online database, National Nuclear Data Center, Brookhaven Laboratory (Upton, NY), November 2006. Refer to <http://www.nndc.bnl.gov/ensdf/>



CANADA CENTRE FOR MINERAL AND ENERGY TECHNOLOGY

REFERENCE URANIUM-THORIUM ORE DL-1a

CERTIFICATE OF ANALYSIS

	Recommended Value	95% Confidence Interval
U	0.0116%	± 0.0003%
Th	0.0076%	± 0.0004%
Ra-226	1.40 Bq/g	± 0.04 Bq/g
Pb-210	1.40 Bq/g	± 0.02 Bq/g

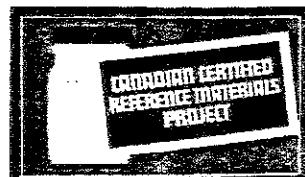
DESCRIPTION

DL-1a is intended as a replacement for DL-1 of which the stock is exhausted. It is waste rock typical of the property of Denison Mines Limited in Elliot Lake, Ontario, and is a pale yellow arkose sandstone containing uraninite and brannerite and possibly traces of monazite and uranothorite. The bulk material was dry-ground to minus 74 µm, blended, sampled systematically for analysis by optical fluorimetric and chemical methods to demonstrate homogeneity suitable for use as a reference material, and bottled in 200-g units. Evidence is available that DL-1a is in secular equilibrium.

CERTIFICATION

The consensus value for uranium is the unweighted mean of 286 accepted analytical determinations by 20 laboratories. Methods included titrimetry, colorimetry, fluorimetry, X-ray fluorescence, neutron activation analysis and radiochemistry.

The consensus value for thorium is the unweighted mean of 187 accepted analytical determinations by 14 laboratories. Methods included colorimetry, X-ray fluorescence, neutron activation analysis, radiometry and isotope dilution-mass spectrometry.



NON-CERTIFIED CONSTITUENTS

The concentration of the following constituents are given for information only.

	Value
Fe	0.93%
S	0.41%

INSTRUCTIONS FOR USE

The recommended values for DL-1a pertain to an "as is" basis.

LEGAL NOTICE

The Canadian Certified Reference Materials Project has prepared this reference material and statistically evaluated the analytical data for the interlaboratory certification program to the best of its ability. The Purchaser by receipt hereof releases and indemnifies the Canadian Certified Reference Materials Project from and against all liability and costs arising out of the use of this material and information.

REFERENCE

The preparation and certification procedures used for DL-1a are given in CANMET Reports 80-10 "DL-1a: A Certified Uranium-Thorium Reference Ore", 83-9E "Radium-226 in Certified Uranium References Ores DL-1a, BL-4a, DH-1a and BL-5" and 84-11E "Lead-210 in Certified Uranium Reference Ores DL-1a, BL-4a, DH-1a and BL-5" which are available free of charge on application to:

Coordinator, CCRMP

CANMET

555 Booth Street

Ottawa, Ontario K1A OG1

Canada

This Certificate of Analysis is available in French on request to the Coordinator, CCRMP.

Inter-Mountain Laboratories - RadChem Standards Notebook

Date: 1/28/16	Standard: Radium 226 11.06g Radium 226 standard 7.5 mL 2mL Nitric Acid (2014093036) was brought up to 100mL DI	pCi/mL L for 1/4mL 5.54 pCi/mL L	RADSTD-15-1
Expires: 1/28/17	Reference Date: 1/1/07		Initials: mB
Date: 2/16/16	Standard: Po-210 standard 0.3259g Po-210 (182341) and 2mL Nitric Acid (2014093036) was brought up to 100mL DI	pCi/mL L 2/16/17 24,778-22,804 pCi/mL L	RADSTD-15-2
Expires: 2/16/17	Reference Date: 8/1/15 11:00 MST		Initials: ms
Date: 3/10/16	Standard: DL-1a Canned DL-1a - 150.02 grams	pCi/mL L	RADSTD-15-3
Expires: Never	Reference Date:		Initials: T.P.
Date: 3/21/16	Standard: Thorium 229 0.9441g thorium 229 (SRM4328C) and 4mL nitric (2014093036) was brought up to 200mL DI	pCi/mL L	RADSTD-15-4
Expires: 3/31/17	Reference Date: 12/31/07 / EST 12:00		Initials: mB
Date: 3/31/16	Standard: Radium 228 standard 2.8902g Radium 228 (43395) and 4mL Nitric Acid (2014093036) brought up to 200mL DI	39.48 pCi/mL L	RADSTD-15-5
Expires: 3/31/16	Reference Date: 10/7/16 12:00 EST		Initials: mB
Date: 4/15/16	Standard: Radium -222 1mL RADSTO 1-1 and 9mL DI and scintilliator oil 10mL	pCi/mL L	RADSTD-15-6
Expires:	Reference Date: 9/9/1991 12:00 EST		Initials: ms
Date: 4/18/16	Standard: BL-4A Canned BL-4A + 57.73 157.39 3 made	pCi/mL L	RADSTD-15-7
Expires: Never	Reference Date:		Initials: mB

ILE

om Page No. _____

Preparation of Radium 226

Standard from UTS-4

by Tom Potts

11-12-10

OHAUS Balance check with weights 54106

$$\begin{aligned}100\text{ g} &= 100.01\text{ g} \\50\text{ g} &= 50.00 \\5\text{ g} &= 5.00\end{aligned}$$

TARE 190.20 grams Sand \Rightarrow 211.35g

UTS-4 = 5.00 grams

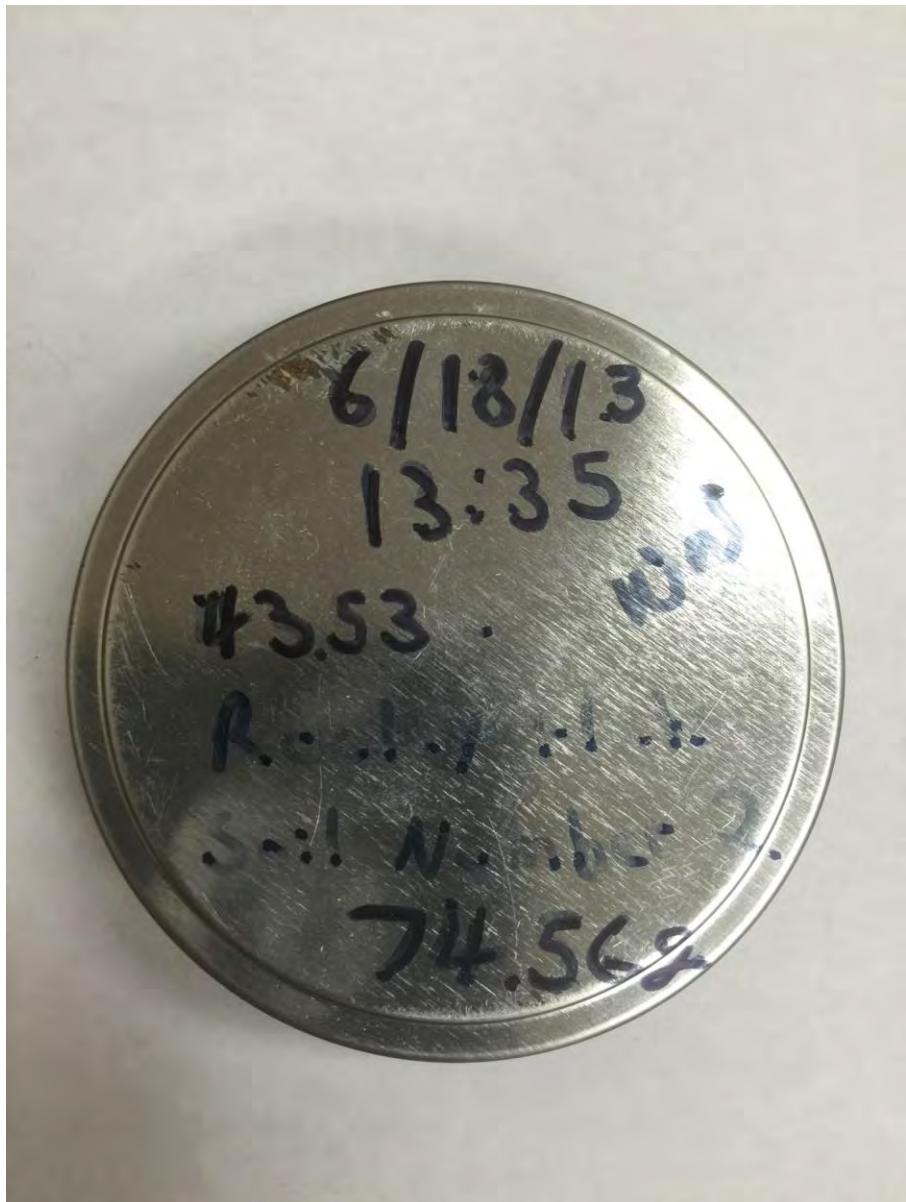
Total weight = 195.20 grams

Canned & Sealed 11-12-10

UTS-4-CAN

Homogenized with a loss of 0.04 grams 1.8.

To Page No. _____



RADSTD15.3-2HRS.Rpt

Detector #2	ACQ	19-Jun-2016 at 10:50:05	RT =	7238.5	LT =	7200.0		
Rad	Chem	2						
RADSTD15-2HRS								
ROI#	RANGE(keV)	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
μCi	+/-							
1	606.93 611.75 0.0050 0.0000	17537	16502	139	609.13	1.28	1.98	Bi-214 609.00
2	659.29 664.11 0.0000 0.0000	609	-43	42	661.15	0.38	0.55	Cs-137 661.66
3	724.58 729.84 0.0015 0.0001	1143	643	47	727.03	1.25	2.34	Bi-212 727.00
4	765.77 771.02	2161	1290	63	768.15	1.22	1.97	No close library
match!								
5	857.99 863.25	757	290	42	860.43	1.07	2.17	No close library
match!								
6	908.38 914.07 0.0012 0.0000	2273	1598	62	910.92	1.43	2.25	Ac-228 911.00
7	966.21 971.90 0.0013 0.0001	1509	1027	52	968.73	1.47	2.33	Ac-228 968.97
8	998.19 1003.88	623	200	40	1000.67	1.44	2.05	No close library
match!								
9	1059.08 1065.21 0.0000 0.0000	420	62	37	1064.21	0.68	1.35	Bi-207 1063.00
10	1117.34 1123.47	3766	3307	71	1119.99	1.63	2.50	No close library
match!								
11	1170.34 1176.47 0.0000 0.0000	359	69	34	1173.51	0.54	1.05	Co-60 1173.20
12	1235.17 1241.30	1582	1219	51	1237.76	1.55	2.50	No close library
match!								
13	1269.55 1276.12	364	80	35	1273.73	0.33	1.17	No close library
match!								
14	1329.34 1335.91	321	26	35	1333.69	0.27	0.48	No close library
match!								
15	1457.88 1464.45	1476	1083	52	1460.38	1.87	2.84	No close library
match!								
16	1761.13 1768.13	2905	2679	60	1764.00	2.04	3.05	No close library
match!								

RADSTD15.3-2HRS-2.Rpt

Detector #2	ACQ	22-Jun-2016 at 12:53:53	RT = 7237.1	LT = 7200.0				
Rad	Chem	2						
ROI#	RANGE(keV)	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
Bq	+/-							
1	606.93 182.18	611.75 1.54	17314	16336	138	609.07	1.27	1.96 Bi-214 609.00
2	659.29 0.00	664.11 0.28	634	-45	43	660.17	0.22	0.35 Cs-137 661.66
3	724.58 53.25	729.84 4.35	1220	612	50	726.95	1.40	2.00 Bi-212 727.00
4	765.77	771.02	2118	1218	63	768.10	1.18	2.00 No close library
match!								
5	857.99	863.25	799	295	43	860.23	1.36	1.99 No close library
match!								
6	908.38 45.50	914.07 1.64	2296	1697	61	910.83	1.54	2.32 Ac-228 911.00
7	966.21 49.38	971.90 2.33	1401	1018	48	968.60	1.33	2.25 Ac-228 968.97
8	998.19	1003.88	692	287	41	1000.87	0.86	1.85 No close library
match!								
9	1059.08 0.33	1065.21 0.43	431	30	39	1062.20	0.31	0.58 Bi-207 1063.00
10	1117.34	1123.47	3788	3208	73	1119.96	1.57	2.44 No close library
match!								
11	1170.34 0.26	1176.47 0.34	371	28	36	1173.63	0.24	0.38 Co-60 1173.20
12	1235.17	1241.30	1548	1181	50	1237.71	1.75	2.48 No close library
match!								
13	1269.55	1276.12	317	-14	36	1275.27	0.46	0.71 No close library
match!								
14	1329.34	1335.91	337	-20	38	1333.72	0.22	0.35 No close library
match!								
15	1457.88	1464.45	1616	1197	54	1460.30	1.75	2.84 No close library
match!								
16	1761.13	1768.13	2820	2594	60	1763.86	1.88	3.10 No close library
match!								

MB-358.Rpt

Detector #1 ACQ 24-Dec-2015 at 10:58:28 RT = 7206.8 LT = 7200.0
 Rad Chem 1
 MB-358

ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY	(keV)
1	607.80 612.63 0.0000 0.0000	127	35	17	609.80	0.34	0.91	Bi-214	609.31
2	660.21 665.47 0.0000 0.0000	52	-15	14	664.81	0.22	0.35	Cs-137	661.66
3	724.23 729.94 0.0000 0.0000	69	15	14	725.11	3.44	3.68	Bi-212	727.00
4	766.11 772.03 0.0001 0.0000	52	24	11	768.55	0.29	1.16	Bi-214	768.36
5	823.77 829.47 0.0000 0.0320	47	-3	13	824.65	0.22	0.35	Co-60	826.28
6	844.60 850.30 0.0000 0.0000	114	51	16	847.73	0.56	1.90	Co-56	846.77
7	857.32 863.02 0.0000 0.0000	49	-23	15	857.97	0.22	0.35	Tl-208	860.56
8	908.62 914.32 0.0000 0.0000	41	5	11	912.34	1.16	1.39	Ac-228	911.20
9	965.83 971.97 0.0000 0.0000	47	13	11	969.81	0.32	1.09	Ac-228	968.97
10	998.71 1004.85 0.0001 0.0003	37	3	11	1000.91	3.51	3.64	Pa-234M	1001.03
11	1060.09 1066.23	29	-10	11	Could not properly fit the peak.				
12	1118.17 1124.31 0.0000 0.0000	54	10	13	1121.06	0.35	0.95	Bi-214	1120.29
13	1170.34 1176.48 0.0000 0.0000	22	17	5	1171.00	3.07	3.20	Co-60	1173.24
14	1233.24 1241.13 0.0001 0.0001	43	18	12	1234.55	4.93	5.13	Bi-214	1238.11
15	1270.72 1277.29 match!	13	8	5	1273.78	0.33	0.53	No close library	
16	1329.88 1336.46	24	-12	11	Could not properly fit the peak.				
17	1457.64 1464.65 0.0002 0.0000	85	57	13	1461.64	0.75	2.50	K-40	1461.00
18	1762.38 1769.83 0.0001 0.0000	43	25	10	1765.67	0.65	0.79	Bi-214	1764.49

MB-11033.Rpt

Detector #1 ACQ 10-Nov-2015 at 9:24:46 RT = 7206.8 LT = 7200.0
 Rad Chem 1
 MB-297

ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
1	607.80 612.63 0.0000 0.0000	146	54	17	610.12	0.47	0.75	Bi-214 609.31
2	660.21 665.47 0.0000 0.0000	51	-3	12	661.09	0.22	0.35	Cs-137 661.66
3	724.23 729.94 0.0000 0.0000	64	1	14	727.74	0.22	0.35	Bi-212 727.00
4	766.11 772.03 0.0000 0.0001	65	4	15	768.62	0.54	1.29	Bi-214 768.36
5	823.77 829.47 0.0000 0.0271	36	-5	11	825.21	0.41	0.56	Co-60 826.28
6	844.60 850.30 0.0000 0.0000	99	58	14	847.00	0.28	0.49	Co-56 846.77
7	857.32 863.02 0.0000 0.0000	44	21	10	859.61	1.61	1.81	Tl-208 860.56
8	908.62 914.32 0.0000 0.0000	43	-7	12	911.47	1.42	1.84	Ac-228 911.20
9	965.83 971.97 0.0000 0.0000	46	12	11	968.46	1.48	1.64	Ac-228 968.97
10	998.71 1004.85 0.0001 0.0003	39	5	11	1001.34	0.22	0.35	Pa-234M 1001.03
11	1060.09 1066.23 match!	38	-1	12	1062.28	0.22	0.35	No close library
12	1118.17 1124.31 0.0000 0.0000	58	19	12	1120.96	0.80	1.27	Bi-214 1120.29
13	1170.34 1176.48 0.0000 0.0000	30	-14	12	1172.31	0.22	0.35	Co-60 1173.24
14	1233.24 1241.13 0.0000 0.0000	52	9	15	1239.27	0.42	0.83	Co-56 1238.28
15	1270.72 1277.29 match!	35	4	11	1272.25	0.27	0.48	No close library
16	1329.88 1336.46	16	0	8	Could not properly fit the peak.			
17	1457.64 1464.65 0.0002 0.0000	77	66	10	1461.86	0.53	1.83	K-40 1461.00
18	1762.38 1769.83 0.0001 0.0000	52	46	8	1766.55	0.25	0.40	Bi-214 1764.49

MB-11050.Rpt

Detector #1 ACQ 17-Nov-2015 at 15:37:14 RT = 7207.1 LT = 7200.0
 Rad Chem 1
 MB-321

ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
1	607.80 612.63 0.0000 0.0000	115	73	13	610.02	0.38	1.52	Bi-214 609.31
2	660.21 665.47 0.0000 0.0000	53	7	12	661.63	0.47	1.05	Cs-137 661.66
3	724.23 729.94 0.0000 0.0000	50	-9	14	728.18	1.43	1.62	Bi-212 727.00
4	766.11 772.03 0.0000 0.0001	55	-1	14	769.84	0.22	0.35	Bi-214 768.36
5	823.77 829.47 0.0000 0.0295	44	-6	12	825.97	0.22	0.35	Co-60 826.28
6	844.60 850.30 0.0000 0.0000	85	49	13	847.82	0.60	1.60	Co-56 846.77
7	857.32 863.02 0.0000 0.0000	46	1	12	860.61	1.21	1.40	Tl-208 860.56
8	908.62 914.32 0.0000 0.0000	50	32	9	912.34	0.24	0.38	Ac-228 911.20
9	965.83 971.97 0.0000 0.0000	27	12	8	967.59	2.85	2.98	Ac-228 968.97
10	998.71 1004.85 0.0003 0.0003	50	11	12	1001.22	0.48	0.94	Pa-234M 1001.03
11	1060.09 1066.23 match!	27	12	8	1060.75	0.22	0.35	No close library
12	1118.17 1124.31 0.0000 0.0000	46	12	11	1121.78	0.41	0.56	Bi-214 1120.29
13	1170.34 1176.48	28	-30	13	Could not properly fit the peak.			
14	1233.24 1241.13 0.0000 0.0000	63	-17	19	1239.16	0.44	0.92	Co-56 1238.28
15	1270.72 1277.29	20	-1	9	Could not properly fit the peak.			
16	1329.88 1336.46	16	-10	9	Could not properly fit the peak.			
17	1457.64 1464.65 0.0002 0.0000	74	63	10	1461.66	0.64	2.38	K-40 1461.00
18	1762.38 1769.83 0.0001 0.0000	53	30	11	1765.13	1.33	1.68	Bi-214 1764.49

MB-11066.Rpt

Detector #1	ACQ	19-Nov-2015 at 15:10:18	RT = 7207.5	LT = 7200.0
Rad	Chem	1		
MB-323				
ROI#	RANGE(keV)	GROSS	NET	+/-
	μ Ci	+/-		
1	607.80 612.63 0.0000 0.0000	152	87	16
2	660.21 665.47 0.0000 0.0000	64	-11	15
3	724.23 729.94 0.0000 0.0000	45	13	11
4	766.11 772.03 0.0000 0.0001	61	0	14
5	823.77 829.47 0.0000 0.0295	45	0	12
6	844.60 850.30 0.0000 0.0000	95	45	14
7	857.32 863.02 0.0000 0.0000	32	9	9
8	908.62 914.32 0.0000 0.0000	49	22	10
9	965.83 971.97 0.0000 0.0000	45	-3	13
10	998.71 1004.85 0.0000 0.0003	36	-8	12
11	1060.09 1066.23 match!	24	-5	10
12	1118.17 1124.31 0.0000 0.0000	64	20	13
13	1170.34 1176.48 0.0000 0.0000	29	0	10
14	1233.24 1241.13 0.0001 0.0001	42	11	13
15	1270.72 1277.29 match!	36	5	11
16	1329.88 1336.46 0.0000 0.0000	23	18	6
17	1457.64 1464.65 0.0002 0.0000	64	47	11
18	1762.38 1769.83 0.0001 0.0000	41	35	7

MB-11089.Rpt

Detector #1	ACQ	27-Nov-2015 at 21:11:20	RT = 7206.8	LT = 7200.0				
Rad	Chem	1						
MB-331								
ROI#	RANGE(keV)	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (kev)
	μ Ci	+/-						
1	607.80 612.63 0.0000 0.0000	129	79	14	609.88	0.95	1.38	Bi-214 609.31
2	660.21 665.47 0.0000 0.0000	63	-12	15	Could not properly fit the peak.			
3	724.23 729.94 0.0000 0.0000	54	-9	14	728.40	0.33	0.53	Bi-212 727.00
4	766.11 772.03 0.0000 0.0001	66	10	14	769.62	0.26	0.44	Bi-214 768.36
5	823.77 829.47 0.0049 0.0295	43	2	12	825.75	0.22	0.35	Co-60 826.28
6	844.60 850.30 0.0000 0.0000	76	49	11	847.44	0.36	2.22	Co-56 846.77
7	857.32 863.02 0.0000 0.0000	48	3	12	859.29	0.22	0.35	Tl-208 860.56
8	908.62 914.32 0.0000 0.0000	56	24	11	912.32	0.27	1.14	Ac-228 911.20
9	965.83 971.97 0.0000 0.0000	44	15	11	969.34	0.25	0.39	Ac-228 968.97
10	998.71 1004.85 0.0004 0.0003	40	16	10	999.37	4.60	4.73	Pa-234M1001.03
11	1060.09 1066.23 match!	29	10	9	1064.47	0.22	0.35	No close library
12	1118.17 1124.31 0.0000 0.0000	58	24	12	1121.20	1.37	1.72	Bi-214 1120.29
13	1170.34 1176.48 0.0000 0.0000	18	-1	8	1174.50	0.33	0.53	Co-60 1173.24
14	1233.24 1241.13 0.0000 0.0000	39	8	12	1238.50	0.22	0.35	Co-56 1238.28
15	1270.72 1277.29 match!	28	2	10	1275.76	0.22	0.35	No close library
16	1329.88 1336.46 0.0000 0.0000	25	20	6	1330.54	5.37	5.57	Co-60 1332.50
17	1457.64 1464.65 0.0001 0.0000	47	30	10	1462.68	0.33	1.82	K-40 1461.00
18	1762.38 1769.83 0.0001 0.0000	43	20	11	1765.45	0.82	1.24	Bi-214 1764.49

MB-11117.Rpt

Detector #1	ACQ	02-Dec-2015 at 19:18:00	RT = 7207.4	LT = 7200.0
Rad	Chem	1		
MB-336				
ROI#	RANGE(keV)	GROSS	NET	+/-
	μCi	+/-		
1	607.80 612.63 0.0000 0.0000	130	69	15
2	660.21 665.47 0.0000 0.0000	64	6	13
3	724.23 729.94 0.0000 0.0000	58	4	13
4	766.11 772.03 0.0001 0.0000	57	20	12
5	823.77 829.47 0.0000 0.0345	47	-16	14
6	844.60 850.30 0.0000 0.0000	97	61	13
7	857.32 863.02 0.0000 0.0000	46	10	11
8	908.62 914.32 0.0000 0.0000	53	-1	13
9	965.83 971.97 0.0000 0.0000	42	13	11
10	998.71 1004.85 0.0000 0.0003	36	-3	12
11	1060.09 1066.23 match!	27	-7	11
12	1118.17 1124.31 0.0001 0.0000	52	37	9
13	1170.34 1176.48 0.0000 0.0000	26	-13	11
14	1233.24 1241.13 0.0000 0.0000	50	31	11
15	1270.72 1277.29 match!	33	2	11
16	1329.88 1336.46	22	-25	13
17	1457.64 1464.65 0.0001 0.0000	72	33	14
18	1762.38 1769.83 0.0001 0.0000	43	37	8
				1765.89
				0.37
				1.42
				Bi-214 1764.49

MB-11169.Rpt

Detector #1 ACQ 15-Dec-2015 at 10:28:51 RT = 7208.2 LT = 7200.0
 Rad Chem 1
 MB-336

ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
1	607.80 612.63 0.0000 0.0000	132	74	15	609.75	0.73	2.20	Bi-214 609.31
2	660.21 665.47 0.0000 0.0000	62	-5	14	663.72	0.22	0.35	Cs-137 661.66
3	724.23 729.94 0.0000 0.0000	48	-11	13	727.96	0.22	0.35	Bi-212 727.00
4	766.11 772.03 0.0001 0.0001	74	18	14	767.87	0.66	0.79	Bi-214 768.36
5	823.77 829.47 0.0000 0.0320	44	-15	13	826.62	0.22	0.35	Co-60 826.28
6	844.60 850.30 0.0000 0.0000	99	54	14	847.64	1.32	2.02	Co-56 846.77
7	857.32 863.02 0.0000 0.0000	43	2	12	858.41	1.75	1.89	Tl-208 860.56
8	908.62 914.32 0.0000 0.0000	52	29	10	912.05	0.42	0.63	Ac-228 911.20
9	965.83 971.97 0.0000 0.0000	36	-3	12	968.68	0.27	0.99	Ac-228 968.97
10	998.71 1004.85 0.0007 0.0002	40	25	9	1003.72	0.35	1.39	Pa-234M 1001.03
11	1060.09 1066.23 match!	21	-3	9	1060.75	0.22	0.35	No close library
12	1118.17 1124.31 0.0000 0.0000	55	21	12	1120.75	0.47	2.15	Bi-214 1120.29
13	1170.34 1176.48 0.0000 0.0000	28	-6	11	1172.75	0.22	0.35	Co-60 1173.24
14	1233.24 1241.13 0.0000 0.0000	39	39	6	1239.32	0.55	1.96	Co-56 1238.28
15	1270.72 1277.29 match!	28	-13	12	1272.25	0.33	0.53	No close library
16	1329.88 1336.46	17	-4	9	Could not properly fit the peak.			
17	1457.64 1464.65 0.0001 0.0000	66	38	12	1462.04	0.48	1.20	K-40 1461.00
18	1762.38 1769.83 0.0001 0.0000	41	35	7	1766.28	0.33	0.85	Bi-214 1764.49

MB-11303.Rpt

Detector #1 ACQ 18-Jan-2016 at 16:35:25 RT = 7210.3 LT = 7200.0
 Rad Chem 1
 MB-018

ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
1	607.80 612.63 0.0000 0.0000	141	76	16	609.85	0.52	1.47	Bi-214 609.31
2	660.21 665.47 0.0000 0.0000	59	9	12	662.18	0.22	0.35	Cs-137 661.66
3	724.23 729.94 0.0000 0.0000	60	1	14	725.11	3.29	3.42	Bi-212 727.00
4	766.11 772.03 0.0000 0.0000	51	4	13	766.77	0.22	0.35	Bi-214 768.36
5	823.77 829.47 0.0049 0.0295	47	2	12	828.63	0.29	0.50	Co-60 826.28
6	844.60 850.30 0.0000 0.0000	102	43	15	847.53	0.52	1.77	Co-56 846.77
7	857.32 863.02 0.0000 0.0000	34	-7	11	861.04	0.26	0.44	Tl-208 860.56
8	908.62 914.32 0.0000 0.0000	70	20	13	912.23	0.92	1.64	Ac-228 911.20
9	965.83 971.97 0.0000 0.0000	41	2	12	969.56	0.22	0.35	Ac-228 968.97
10	998.71 1004.85 0.0010 0.0002	41	36	7	1000.80	0.39	0.55	Pa-234M 1001.03
11	1060.09 1066.23 match!	31	21	7	1063.12	0.35	1.83	No close library
12	1118.17 1124.31 0.0000 0.0000	53	24	11	1120.69	0.40	0.61	Bi-214 1120.29
13	1170.34 1176.48 0.0000 0.0000	34	15	9	1174.72	0.22	0.35	Co-60 1173.24
14	1233.24 1241.13 0.0000 0.0000	40	3	13	1238.54	0.32	1.31	Co-56 1238.28
15	1270.72 1277.29 match!	20	15	6	1276.06	0.87	1.00	No close library
16	1329.88 1336.46 0.0000 0.0000	19	14	5	1335.58	0.27	0.48	Co-60 1332.50
17	1457.64 1464.65 0.0001 0.0000	60	38	11	1461.14	0.25	0.40	K-40 1461.00
18	1762.38 1769.83 0.0001 0.0000	54	25	12	1765.35	1.63	1.84	Bi-214 1764.49

MB-11304.Rpt

Detector #1 ACQ 19-Jan-2016 at 16:25:39 RT = 7210.2 LT = 7200.0
 Rad Chem 1
 MB-019

ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
1	607.80 612.63 0.0000 0.0000	163	105	16	609.63	1.02	1.77	Bi-214 609.31
2	660.21 665.47 0.0000 0.0000	67	9	13	663.75	0.31	0.54	Cs-137 661.66
3	724.23 729.94 0.0000 0.0000	42	19	9	727.82	0.89	2.02	Bi-212 727.00
4	766.11 772.03 0.0001 0.0000	65	18	13	768.30	0.26	0.44	Bi-214 768.36
5	823.77 829.47 0.0000 0.0295	45	0	12	824.43	2.19	2.32	Co-60 826.28
6	844.60 850.30 0.0000 0.0000	101	42	15	847.01	0.95	1.59	Co-56 846.77
7	857.32 863.02 0.0000 0.0000	47	2	12	859.29	0.22	0.35	Tl-208 860.56
8	908.62 914.32 0.0000 0.0000	58	17	12	912.56	0.25	0.39	Ac-228 911.20
9	965.83 971.97 0.0000 0.0000	44	-14	14	966.49	0.22	0.35	Ac-228 968.97
10	998.71 1004.85 0.0002 0.0003	38	9	10	1003.54	0.26	0.44	Pa-234M 1001.03
11	1060.09 1066.23	30	-14	12	Could not properly fit the peak.			
12	1118.17 1124.31 0.0000 0.0000	54	15	12	1120.89	0.45	0.99	Bi-214 1120.29
13	1170.34 1176.48 0.0000 0.0000	30	-4	11	1171.00	0.88	1.01	Co-60 1173.24
14	1233.24 1241.13 0.0001 0.0001	45	26	11	1234.12	5.37	5.65	Bi-214 1238.11
15	1270.72 1277.29 match!	37	6	11	1273.24	0.43	0.65	No close library
16	1329.88 1336.46 0.0000 0.0000	27	-4	11	1330.98	4.82	4.95	Co-60 1332.50
17	1457.64 1464.65 0.0002 0.0000	71	54	11	1461.97	0.88	1.75	K-40 1461.00
18	1762.38 1769.83 0.0001 0.0000	38	38	6	1765.67	1.17	1.62	Bi-214 1764.49

MB-11319.Rpt

Detector #1 ACQ 22-Jan-2016 at 15:59:31 RT = 7209.2 LT = 7200.0
 Rad Chem 1
 MB-022

ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
1	607.80 612.63 0.0000 0.0000	162	85	17	609.81	1.20	1.97	Bi-214 609.31
2	660.21 665.47 0.0000 0.0000	48	6	11	664.37	0.26	0.44	Cs-137 661.66
3	724.23 729.94 0.0000 0.0000	52	20	11	726.74	1.82	3.34	Bi-212 727.00
4	766.11 772.03 0.0000 0.0001	60	-1	14	768.63	0.80	0.98	Bi-214 768.36
5	823.77 829.47 0.0345 0.0271	46	14	11	826.66	0.32	0.74	Co-60 826.28
6	844.60 850.30 0.0000 0.0000	85	49	13	847.59	0.46	0.75	Co-56 846.77
7	857.32 863.02 0.0000 0.0000	48	-11	13	860.17	0.22	0.35	Tl-208 860.56
8	908.62 914.32 0.0000 0.0000	50	5	12	911.47	0.25	0.39	Ac-228 911.20
9	965.83 971.97 0.0000 0.0000	41	-3	12	969.88	0.39	0.55	Ac-228 968.97
10	998.71 1004.85 0.0003 0.0003	40	11	11	1002.12	0.41	0.56	Pa-234M 1001.03
11	1060.09 1066.23 match!	21	11	6	1060.75	1.42	1.62	No close library
12	1118.17 1124.31 0.0001 0.0000	59	59	7	1121.33	0.79	1.78	Bi-214 1120.29
13	1170.34 1176.48 0.0000 0.0000	23	8	8	1171.00	0.26	0.96	Co-60 1173.24
14	1233.24 1241.13 0.0001 0.0000	36	17	10	1235.43	1.75	1.88	Bi-214 1238.11
15	1270.72 1277.29 match!	21	5	8	1271.37	2.63	2.76	No close library
16	1329.88 1336.46	23	-3	10	Could not properly fit the peak.			
17	1457.64 1464.65 0.0002 0.0000	70	64	9	1461.08	1.84	3.60	K-40 1461.00
18	1762.38 1769.83 0.0001 0.0000	42	24	10	1765.08	1.00	1.19	Bi-214 1764.49

MB-11381.Rpt

Detector #1 ACQ 09-Feb-2016 at 13:22:38 RT = 7210.0 LT = 7200.0
 Rad Chem 1
 MB-11372

ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
1	607.80 612.63 0.0000 0.0000	145	45	18	609.89	0.65	0.96	Bi-214 609.31
2	660.21 665.47 0.0000 0.0000	56	6	12	661.20	0.84	1.00	Cs-137 661.66
3	724.23 729.94 0.0001 0.0000	59	27	11	727.55	0.29	0.50	Bi-212 727.00
4	766.11 772.03 0.0001 0.0001	68	17	14	768.78	0.35	0.83	Bi-214 768.36
5	823.77 829.47 0.0000 0.0320	48	-11	13	824.87	0.22	0.35	Co-60 826.28
6	844.60 850.30 0.0000 0.0000	90	40	14	847.45	0.40	0.93	Co-56 846.77
7	857.32 863.02 0.0000 0.0000	36	9	10	858.19	0.27	0.48	Tl-208 860.56
8	908.62 914.32 0.0000 0.0000	56	24	11	911.58	0.91	2.34	Ac-228 911.20
9	965.83 971.97 0.0000 0.0000	36	17	9	970.54	0.42	1.49	Ac-228 968.97
10	998.71 1004.85 0.0003 0.0003	40	11	11	999.37	0.22	0.35	Pa-234M 1001.03
11	1060.09 1066.23 match!	29	-10	11	1061.19	0.33	0.53	No close library
12	1118.17 1124.31 0.0000 0.0000	48	0	13	1120.37	1.37	1.58	Bi-214 1120.29
13	1170.34 1176.48	19	0	8	Could not properly fit the peak.			
14	1233.24 1241.13 0.0000 0.0000	36	-7	14	1239.48	0.41	0.56	Co-56 1238.28
15	1270.72 1277.29	19	-7	10	Could not properly fit the peak.			
16	1329.88 1336.46 0.0000 0.0000	23	-8	11	1335.80	0.22	0.35	Co-60 1332.50
17	1457.64 1464.65 0.0001 0.0000	55	38	10	1461.97	0.44	1.23	K-40 1461.00
18	1762.38 1769.83 0.0001 0.0000	42	30	9	1766.33	0.24	0.39	Bi-214 1764.49

MB-11412.Rpt

Detector #1 Rad MB-11412	ACQ Chem 1	18-Feb-2016 at 8:43:01	RT = 7207.5	LT = 7200.0				
ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
1	607.80 612.63 0.0000 0.0000	136	67	16	609.35	0.38	1.48	Bi-214 609.31
2	660.21 665.47 0.0000 0.0000	55	17	11	663.16	0.39	0.55	Cs-137 661.66
3	724.23 729.94	56	-25	16	Could not properly fit the peak.			
4	766.11 772.03 0.0000 0.0001	63	-2	15	770.28	0.22	0.35	Bi-214 768.36
5	823.77 829.47 0.0123 0.0295	50	5	12	825.53	2.96	3.16	Co-60 826.28
6	844.60 850.30 0.0000 0.0000	104	63	14	847.31	0.51	1.32	Co-56 846.77
7	857.32 863.02 0.0000 0.0000	49	4	12	858.19	0.27	0.48	Tl-208 860.56
8	908.62 914.32 0.0000 0.0000	63	-5	15	910.15	1.75	1.89	Ac-228 911.20
9	965.83 971.97 0.0000 0.0000	40	16	10	968.90	0.26	0.66	Ac-228 968.97
10	998.71 1004.85 0.0000 0.0004	46	-7	14	1002.88	0.22	0.35	Pa-234M 1001.03
11	1060.09 1066.23 match!	27	8	9	1063.60	0.22	0.35	No close library
12	1118.17 1124.31 0.0000 0.0000	60	26	12	1120.63	0.31	0.99	Bi-214 1120.29
13	1170.34 1176.48 0.0000 0.0000	32	27	6	1172.97	0.24	0.39	Co-60 1173.24
14	1233.24 1241.13 0.0001 0.0001	48	11	14	1233.90	6.79	6.93	Bi-214 1238.11
15	1270.72 1277.29 match!	28	18	7	1274.00	2.47	2.67	No close library
16	1329.88 1336.46	26	-15	12	Could not properly fit the peak.			
17	1457.64 1464.65 0.0002 0.0000	82	60	12	1461.35	0.92	1.18	K-40 1461.00
18	1762.38 1769.83 0.0001 0.0000	44	26	10	1766.11	0.27	1.10	Bi-214 1764.49

MB-11466.Rpt

Detector #1 ACQ 01-Mar-2016 at 16:12:34 RT = 7208.6 LT = 7200.0
 Rad Chem 1
 MB-061

ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
1	607.80 612.63 0.0000 0.0000	117	44	15	609.57	0.40	1.41	Bi-214 609.31
2	660.21 665.47 0.0000 0.0000	64	22	12	664.37	0.25	0.39	Cs-137 661.66
3	724.23 729.94 0.0000 0.0000	56	-7	14	727.74	0.22	0.35	Bi-212 727.00
4	766.11 772.03 0.0000 0.0000	47	-4	13	769.18	2.30	2.50	Bi-214 768.36
5	823.77 829.47 0.0000 0.0271	33	-8	11	824.43	1.97	2.10	Co-60 826.28
6	844.60 850.30 0.0000 0.0000	92	47	14	846.54	0.27	0.65	Co-56 846.77
7	857.32 863.02	42	-21	14	Could not properly fit the peak.			
8	908.62 914.32 0.0000 0.0000	46	-8	13	911.69	0.27	0.48	Ac-228 911.20
9	965.83 971.97 0.0000 0.0000	38	-1	12	970.00	0.22	0.35	Ac-228 968.97
10	998.71 1004.85 0.0000 0.0004	47	-16	15	1003.20	0.40	0.55	Pa-234M1001.03
11	1060.09 1066.23 match!	34	-10	12	1065.13	0.33	0.53	No close library
12	1118.17 1124.31 0.0000 0.0000	55	21	12	1120.67	0.48	1.05	Bi-214 1120.29
13	1170.34 1176.48 0.0000 0.0000	30	1	10	1173.63	1.10	1.23	Co-60 1173.24
14	1233.24 1241.13 0.0001 0.0000	41	29	9	1238.06	0.29	3.93	Bi-214 1238.11
15	1270.72 1277.29 match!	28	2	10	1271.81	0.22	0.35	No close library
16	1329.88 1336.46	20	-11	10	Could not properly fit the peak.			
17	1457.64 1464.65 0.0001 0.0000	44	33	9	1462.07	0.46	1.66	K-40 1461.00
18	1762.38 1769.83 0.0001 0.0000	44	26	10	1765.53	0.51	0.96	Bi-214 1764.49

MB-11523.Rpt

Detector #1 ACQ 15-Mar-2016 at 16:23:17 RT = 7208.7 LT = 7200.0
 Rad Chem 1
 MB-075

ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
1	607.80 612.63 0.0000 0.0000	118	49	15	609.08	0.53	1.71	Bi-214 609.31
2	660.21 665.47 0.0000 0.0000	59	-4	13	661.96	0.26	0.44	Cs-137 661.66
3	724.23 729.94 0.0000 0.0000	61	11	13	728.58	0.32	0.74	Bi-212 727.00
4	766.11 772.03 0.0001 0.0000	56	23	11	768.30	0.25	0.39	Bi-214 768.36
5	823.77 829.47	42	-21	14	Could not properly fit the peak.			
6	844.60 850.30 0.0000 0.0000	99	81	12	847.54	0.59	1.74	Co-56 846.77
7	857.32 863.02	39	-15	13	Could not properly fit the peak.			
8	908.62 914.32 0.0000 0.0000	48	25	10	911.23	0.69	1.47	Ac-228 911.20
9	965.83 971.97 0.0000 0.0000	50	2	13	969.56	0.22	0.35	Ac-228 968.97
10	998.71 1004.85 0.0004 0.0003	39	15	10	1003.64	0.88	1.14	Pa-234M 1001.03
11	1060.09 1066.23 match!	30	11	9	1062.72	0.22	0.35	No close library
12	1118.17 1124.31 0.0000 0.0000	57	23	12	1120.15	1.83	2.05	Bi-214 1120.29
13	1170.34 1176.48 0.0000 0.0000	34	15	9	1173.63	1.32	1.45	Co-60 1173.24
14	1233.24 1241.13 0.0000 0.0000	51	20	13	1238.72	0.22	0.35	Co-56 1238.28
15	1270.72 1277.29 match!	23	13	7	1271.59	3.84	4.03	No close library
16	1329.88 1336.46	22	-9	10	Could not properly fit the peak.			
17	1457.64 1464.65 0.0002 0.0000	55	49	8	1461.20	1.03	2.37	K-40 1461.00
18	1762.38 1769.83 0.0001 0.0000	38	32	7	1764.87	0.93	1.98	Bi-214 1764.49

MB-11552.Rpt

Detector #1 ACQ 26-Mar-2016 at 18:57:32 RT = 7207.5 LT = 7200.0
 Rad Chem 1
 MB-086

ROI#	RANGE(keV) μCi +/-	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY (keV)
1	607.80 612.63 0.0000 0.0000	128	17	18	609.78	0.51	0.76	Bi-214 609.31
2	660.21 665.47 0.0000 0.0000	60	14	12	661.96	0.22	0.35	Cs-137 661.66
3	724.23 729.94 0.0000 0.0000	43	-7	12	725.33	2.19	2.32	Bi-212 727.00
4	766.11 772.03 0.0001 0.0000	57	15	13	766.99	0.88	1.01	Bi-214 768.36
5	823.77 829.47 0.0123 0.0271	41	5	11	825.97	0.27	0.70	Co-60 826.28
6	844.60 850.30 0.0000 0.0000	101	60	14	847.31	0.48	1.42	Co-56 846.77
7	857.32 863.02	34	-16	12	Could not properly fit the peak.			
8	908.62 914.32 0.0000 0.0000	54	9	12	909.49	1.97	2.10	Ac-228 911.20
9	965.83 971.97 0.0000 0.0000	45	21	10	969.12	0.88	1.01	Ac-228 968.97
10	998.71 1004.85 0.0003 0.0002	30	11	9	1003.10	0.27	0.48	Pa-234M 1001.03
11	1060.09 1066.23 match!	24	-10	10	1062.94	0.22	0.35	No close library
12	1118.17 1124.31 0.0000 0.0000	55	26	11	1120.75	0.78	1.47	Bi-214 1120.29
13	1170.34 1176.48	22	3	8	Could not properly fit the peak.			
14	1233.24 1241.13 0.0000 0.0000	39	8	12	1239.16	0.27	0.77	Co-56 1238.28
15	1270.72 1277.29 match!	30	-6	12	1275.10	0.22	0.35	No close library
16	1329.88 1336.46 0.0000 0.0000	25	-1	10	1335.58	0.27	0.48	Co-60 1332.50
17	1457.64 1464.65 0.0001 0.0000	65	43	11	1461.16	0.34	1.58	K-40 1461.00
18	1762.38 1769.83 0.0001 0.0000	41	23	10	1765.56	1.03	1.85	Bi-214 1764.49

MB-11595.Rpt

Detector #1	ACQ	07-Apr-2016 at 11:52:35	RT = 7210.1	LT = 7200.0					
Rad	Chem	1							
MB-098									
ROI#	RANGE(keV)	GROSS	NET	+/-	CENTROID	FWHM	FW(1/5)M	LIBRARY	(kev)
	μCi	$^{+/-}$							
1	607.80 612.63 0.0000 0.0000	114	45	15	610.01	0.36	1.72	Bi-214	609.31
2	660.21 665.47 0.0000 0.0000	70	3	14	661.33	0.29	0.61	Cs-137	661.66
3	724.23 729.94 0.0000 0.0000	57	16	12	727.18	2.11	2.89	Bi-212	727.00
4	766.11 772.03 0.0000 0.0000	55	8	13	768.09	0.26	0.75	Bi-214	768.36
5	823.77 829.47	39	-11	12	Could not properly fit the peak.				
6	844.60 850.30 0.0000 0.0000	74	56	10	847.26	0.35	1.46	Co-56	846.77
7	857.32 863.02 0.0000 0.0000	44	17	10	859.61	2.66	2.89	Tl-208	860.56
8	908.62 914.32 0.0000 0.0000	45	4	12	911.47	0.29	1.27	Ac-228	911.20
9	965.83 971.97 0.0000 0.0000	44	-9	13	969.56	0.22	0.35	Ac-228	968.97
10	998.71 1004.85 0.0000 0.0003	41	-3	12	1000.25	0.22	0.35	Pa-234M	1001.03
11	1060.09 1066.23 match!	40	-8	13	1061.19	1.10	1.23	No close library	
12	1118.17 1124.31 0.0000 0.0000	67	23	13	1120.59	0.91	2.41	Bi-214	1120.29
13	1170.34 1176.48 0.0000 0.0000	23	4	8	1172.97	0.27	0.48	Co-60	1173.24
14	1233.24 1241.13 0.0000 0.0000	39	8	12	1238.72	1.31	1.45	Co-56	1238.28
15	1270.72 1277.29 match!	21	-15	11	1276.19	0.22	0.35	No close library	
16	1329.88 1336.46 0.0000 0.0000	16	6	6	1331.20	0.27	0.48	Co-60	1332.50
17	1457.64 1464.65 0.0002 0.0000	71	54	11	1461.57	0.83	1.73	K-40	1461.00
18	1762.38 1769.83 0.0001 0.0000	43	31	9	1765.39	0.61	1.95	Bi-214	1764.49



Inter-Mountain Labs

Sheridan, WY and Gillette, WY

- CHAIN OF CUSTODY RECORD -

Page 1 of 1

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#WEB

Client Name Dawn Mining Company		Project Identification Midnite Mine		Sampler (Signature/Attestation of Authenticity) David Wright Adams				Telephone # 970 420 3750	
Report Address 8809 Washington St. NE Suite 150 Albuquerque, NM 87113		Contact Name Randy Whicker		ANALYSES / PARAMETERS					
Invoice Address		Email randywhicker@ergoffice.com	Phone (970)-556-1174	Purchase Order #	Quote #				
ITEM	LAB ID (Lab Use Only)	DATE SAMPLED	TIME	SAMPLE IDENTIFICATION		Matrix	# of Containers	Ra-226	REMARKS
1	<i>SL607240-001</i>	06/13/16	9:44	CORR16-0015-SOI-DIS-01		SL	1	X	<i>129.43</i> EPA 901.1 Modified
2	<i>002</i>	06/13/16	10:18	CORR17-0015-SOI-DIS-01		SL	1	X	<i>162.16</i> EPA 901.1 Modified
3	<i>003</i>	06/16/16	12:03	CORR18-0015-SOI-DIS-01		SL	1	X	<i>149.85</i> EPA 901.1 Modified
4	<i>004</i>	06/16/16	12:12	CORR19-0015-SOI-DIS-01		SL	1	X	<i>176.13</i> EPA 901.1 Modified
5	<i>005</i>	06/16/16	13:13	CORR20-0015-SOI-DIS-01		SL	1	X	<i>190.98</i> EPA 901.1 Modified
6	<i>006</i>	06/16/16	13:43	CORR21-0015-SOI-DIS-01		SL	1	X	<i>189.06</i> EPA 901.1 Modified
7	<i>007</i>	06/16/16	13:59	CORR22-0015-SOI-DIS-01		SL	1	X	<i>205.19</i> EPA 901.1 Modified
8	<i>008</i>	06/16/16	14:44	CORR23-0015-SOI-DIS-01		SL	1	X	<i>139.96</i> EPA 901.1 Modified
9	<i>009</i>	06/21/16	11:59	CORR24-0015-SOI-DIS-01		SL	1	X	<i>144.95</i> EPA 901.1 Modified
10									
11									
12									
13									
14									
LAB COMMENTS		Relinquished By (Signature/Printed)		DATE	TIME	Received By (Signature/Printed)		DATE	TIME
<i>David W Adams</i>		<i>David W Adams</i>		<i>7/13/0930</i>		<i>Kathy Boys</i>		<i>7.18.16</i>	<i>10:15</i>
SHIPPING INFO		MATRIX CODES		TURN AROUND TIMES		COMPLIANCE INFORMATION		ADDITIONAL REMARKS	
<input type="checkbox"/> UPS	Water	WT	Check desired service		Compliance Monitoring ?		Y / N	Must meet detection limit of <1.0 pCi/g	
<input type="checkbox"/> FedEx	Soil	SL	<input checked="" type="checkbox"/> Standard turnaround		Program (SDWA, NPDES,...)			Count in can use mass (grams) recorded on can	
<input type="checkbox"/> USPS	Solid	SD	<input type="checkbox"/> RUSH - 5 Working Days		PWSID / Permit #			Level IV Reporting REQUIRED	
<input type="checkbox"/> Hand Carried	Filter	FT	<input type="checkbox"/> URGENT - < 2 Working Days		Chlorinated?		Y / N	Deliver Preliminary EDD ASAP	
<input type="checkbox"/> Other	Other	OT	<i>Rush & Urgent Surcharges will be applied</i>		Sample Disposal: Lab		Client	Ensure >21 days has passed since "Date Sealed"	

Corr No-0015-SOI-COM-01
Collected 6/16/16
Sealed 129.43 grams

S1607240-001A RAD_GAMM
CORR16-0015-S A_RA_S
06/13/16 9:44 AM RAD_GAMM
DAWNMINIINGC A_S_PR
preserved

Corr 17-0015-SOI-COM-01
Collected 6/16/16 162.16 grams
Sealed 6/16/16

S1607240-002A RAD_GAMM
CORR17-0015-S A_RA_S
06/13/16 10:18 AM RAD_GAMM
DAWNMINIINGC A_S_PR
preserved

Corr 18-0015-SOI-COM-01
Collected 6/16/16 149.85g
SEALED 6/16/16

S1607240-003A RAD_GAMM
CORR18-0015-S A_RA_S
06/16/16 12:03 PM RAD_GAMM
DAWNMINIINGC A_S_PR
preserved

Corr 19-0015-SOI-COM-01
COLLECTED 6/16/16 176.13g
SEALED 6/16/16

S1607240-004A RAD_GAMM
CORR19-0015-S A_RA_S
06/16/16 12:12 PM RAD_GAMM
DAWNMINIINGC A_S_PR
preserved

Corr 20-0015-SOI-COM-01
Collected 6/16/16 190.98g
Sealed 6/21/16

S1607240-005A RAD_GAMM
CORR20-0015-S A_RA_S
06/16/16 1:13 PM RAD_GAMM
DAWNMINIINGC A_S_PR
preserved

Corr 21-0015-SOI-COM-01
Collected 6/16/16 189.06g
Sealed 6/22/16

S1607240-006A RAD_GAMM
CORR21-0015-S A_RA_S
06/16/16 1:43 PM RAD_GAMM
DAWNMINIINGC A_S_PR
preserved

Corr 22-0015-SOI-COM-01
Collected 6/16/16 205.19g
Sealed 6/22/16

S1607240-007A RAD_GAMM
CORR22-0015-S A_RA_S
06/16/16 1:59 PM RAD_GAMM
DAWNMINIINGC A_S_PR
preserved

Corr 23-0015-SOI-COM-01
Collected 6/16/16 139.96
Sealed 6/22/16

S1607240-008A RAD_GAMM
CORR23-0015-S A_RA_S
06/16/16 2:44 PM RAD_GAMM
DAWNMINIINGC A_S_PR
preserved

Corr 24-0015-SOI-COM-01
COLLECTED 6/16/16 144.95g
SEALED 6/22/16

S1607240-009A RAD_GAMM
CORR24-0015-S A_RA_S
06/21/16 11:59 AM RAD_GAMM
DAWNMINIINGC A_S_PR
preserved



Survey Meter # Model 2241-2 SN# 182115
pH strip lot # HC 5477Q
Thermometer SN# 27130475

Condition Upon Receipt (Attach to COC)

Sample Receipt

- 1 Number of ice chests/packages received: 1

Note as "OTC" if samples are received over the counter, unpackaged

- 2 Temperature of cooler/samples. (If more than 8 coolers, please write on back)

Temps Observed (°C):	15							
Temps Corrected (°C):	15							

Acceptable is: 0.1° to 10°C for Bacteria; and 0.1° to 6°C for most other water parameters. Samples may not have had adequate time to cool following collection. Indicate ROI (Received on Ice) for iced samples received on the same day as sampled, in addition to temperature at receipt.

Client contact for temperatures outside method criteria must be documented below.

- | | | | |
|--|-----|----|-----|
| 3 Emission rate of samples for radiochemical analyses < 0.5mR/hr? | Yes | No | N/A |
| 4 COC Number (If applicable): WEB | | | |
| 5 Do the number of bottles agree with the COC? | Yes | No | N/A |
| 6 Were the samples received intact? (no broken bottles, leaks, etc.) | Yes | No | N/A |
| 7 Were the sample custody seals intact? | Yes | No | N/A |
| 8 Is the COC properly completed, legible, and signed? | Yes | No | |

Sample Verification, Labeling & Distribution

- | | | |
|--|-----|----|
| 1 Were all requested analyses understood and appropriate? | Yes | No |
| 2 Did the bottle labels correspond with the COC information? | Yes | No |
| 3 Samples collected in proper containers? | Yes | No |
| 4 Sample Preservation: | | |

pH at Receipt:	Final pH (if added in lab):	Preservative/Lot#	Date/Time Added:
_____ Total Metals	_____ Total Metals	HNO3 _____	_____
_____ Diss Metals	_____ Diss Metals	Filtered and preserved in metals	Filtered and preserved in metals
_____ Nutrient	_____ Nutrient	H ₂ SO ₄ _____	_____
_____ Cyanide	_____ Cyanide	NaOH _____	_____
_____ Sulfide	_____ Sulfide	ZnAcet _____	_____
_____ Phenol	_____ Phenol	H ₂ SO ₄ _____	_____
_____ TOC	_____ TOC	HCl _____	_____

pH of each WY STP (LAUST) sample must be checked and recorded.

- | | | | |
|---|-----|----|-----|
| 5 VOA vials have <6mm headspace? | Yes | No | N/A |
| 6 Were all analyses within holding time at the time of receipt? | Yes | No | |
| 7 Have rush or project due dates been checked and accepted? | Yes | No | N/A |
| 8 Do samples require subcontracted analyses? | Yes | No | |

If "Yes", which type of subcontracting is required?

General Customer-Specified Certified

Sample Receipt, Verification, Login, Labeling & Distribution completed by (initials): KB

Set ID: 31607240

Discrepancy Documentation (use back of sheet for notes on discrepancies)

Any items listed above with a response of "No" or do not meet specifications must be resolved.

Person Contacted: _____ Method of Contact: _____ Phone: _____

Initiated By: _____ Date/Time: _____ Email: _____

Problem:

Resolution:

1607240
BS 7-20-16 7/21/16

Report Review Checklist

COC Review Information on COC matches that on report; spelling accurate.

	Log Review	Report Review
1 Original COC attached, signed and dated.	/	/
2 Parameters requested.	/	/
3 Client.	/	/
4 Report recipient/address.	/	/
5 Invoice recipient/address.	/	/
6 Project.	/	/
7 Appropriate PQLs selected.	/	/
8 Prices may need to be adjusted prior to invoicing.	Yes or No	/
9 P. O. number.	-	NA
10 Sample IDs.	/	/
11 Sample dates.	/	/
12 Date received.	/	/
13 Date due.	/	/
14 Matrix.	/	/
15 PWSID included for safe drinking water compliance samples.	-	NA
16 Field data entered appropriately, matches lab data.	-	NA
17 Special requests indicated in "Comments" section of Work Order summary.	-	/

Data Review

1 Automated QC (Check Data button) review performed, discrepancies resolved.	/
2 Worksheet/instrument data sheet for all requested parameters attached to data packet.	/
3 Worksheet/instrument data sheet initialed and dated by analyst, indicating review.	/
4 Worksheet/instrument data compared to report results for calculation, transcription and data entry errors.	/
5 Analysis date and time.	/
6 Analytical method.	/
7 Appropriate units of measure.	/
8 Analyst's initials.	/
9 Calculations checked?	/
10 Subcontracted analyses identified as such with qualifier.	NA
11 Invoice parameters match those on COC.	/

Final Review

1 Report appears complete and appropriate.	/
2 Condition Upon Receipt form completed, attached to packet, and related qualifiers included in report.	/
3 All necessary qualifiers included in report.	/
4 Qualifiers referenced in case narrative; which includes descriptions of all sample/analysis anomalies.	/
5 Anomalies explained in Case Narrative.	/
6 Copies of report sent to all recipients requested on COC.	Hard copies. Emailed copies.
7 All special requests listed on COC honored.	/
8 Special report format per client request.	/
9 Report pages signed.	/

Kathy Boyd

From: Wade Nieuwsma [waden@imlinc.com]
Sent: Thursday, July 14, 2016 8:25 AM
To: kboyd@imlinc.com
Subject: FW: Level \$ Final S1607021

FYI

From: Randy Whicker [mailto:randywhicker@ergoffice.com]
Sent: Wednesday, July 13, 2016 4:57 PM
To: Wade Nieuwsma
Cc: Tom Patten
Subject: RE: Level \$ Final S1607021

Thanks Wade – I'll pass these data reports on to Jill Richards for data validation review.

On another note, 37 more canned/sealed soil samples from Midnite Mine were prepared for shipment today and will be picked up by UPS tomorrow (2nd day shipping to IML). There are two batches (with separate COCs) in one cooler. I'd like the batch with nine (9) correlation samples analyzed ASAP by gamma for Ra-226, with a preliminary EDD sent right away (still followed by level 4 reporting as you get that information completed). After the gamma counting, these 9 samples will need to be shipped back to my attention at the Dawn Mining Company Millsite (P.S. I received the last batch of 10 samples back okay – thank you).

With respect to the other 27 samples (the second batch), these are Final Status Survey (FSS) samples that require gamma counting first (for Ra-226), then they need to be unsealed and processed for analysis of U-nat and Pb-210. Special instructions are provided for these 27 samples – Level IV reporting required, but again, I'd like a preliminary EDD sent as soon as it is ready.

Please let me know if you or Tom have any questions. I really appreciate IML's willingness to accommodate our special requests on this project – things are working out well thus far.

Thanks,

*Randy Whicker, CHP
Senior Health Physicist*



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